UNIVERSITY OF ILLINOIS BULLETIN

ISSUED WEEKLY

Vol. XII JUNE 28, 1915 No. 43

[Entered as second-class matter December 11, 1912, at the Post Office at Urbana, Ill., under Act of August 24, 1912]

HIGH SCHOOL MANUAL

STANDARDS AND GENERAL RECOMMENDATIONS FOR ACCREDITING OF HIGH SCHOOLS

OFFICE OF HIGH SCHOOL VISITOR

PUBLISHED BY
THE UNIVERSITY OF ILLINOIS, URBANA
1915

UNIVERSITY OF ILLINOIS BULLETIN

ISSUED WEEKLY

Vol. XII JUNE 28, 1915 No. 43

Entered as second-class matter December 11, 1912, at the Post Office at Urbana, Ill., under Act of August 24, 1912]

HIGH SCHOOL MANUAL

STANDARDS AND GENERAL RECOMMENDATIONS FOR ACCREDITING OF HIGH SCHOOLS

OFFICE OF HIGH SCHOOL VISITOR

PUBLISHED BY

THE UNIVERSITY OF ILLINOIS, URBANA

1915

INDEX OF CONTENTS.

INTRODUCTORY.

For more than thirty years the University of Illinois has extended to such high schools of the state as have sought approval and have been found to maintain satisfactory standards of instruction the privilege of entrance to the university on certificate of such of their graduates as might seek admission.

The basis for granting such privilege to high schools has been visitation and inspection. For the past nineteen years this has been through a special officer of the University whose title is that of High School Visitor. Previous to that time it was done through committees of the faculty.

In this work of visitations for the purpose of establishing the accredited relation between high schools and the University the aim has been to aid the high schools, in a constructive way, to develop their normal functions toward the communities which they serve. To further this purpose in more recent years annual conferences have been held. To the same end the University has also sought to cooperate with school authorities in counties in such a manner as to bring about better standards of high school work in villages able to maintain only two or three years of high school work.

The following information in regard to entrance requirements, standards required for accrediting, and the material equipment of schools has been compiled for the purpose of furthering the ends and aims as above mentioned. This manual is for the use of school superintendents and principals, and school boards.

I

ADMISSION

GENERAL STATEMENT

An applicant for admission to any of the colleges or schools of the University must be at least sixteen years of age. Candidates for admission to the college of Dentistry (Chicago) must be eighteen and candidates for admission to the School of Pharmacy (Chicago) must be seventeen years of age.

Women are admitted to all departments under the same conditions and on the same terms as men.

Students may be admitted at any time, but should enter if possible at the beginning of the fall semester (in 1915, September 20), or at the beginning of the spring semester (in 1916, February 7). Students can seldom enter the College of Engineering to advantage except at the opening of the school year in September.

The entrance requirements for the undergraduate departments including the colleges of Liberal Arts and Sciences, Engineering, and Agriculture, and the School of Music, amounting in each case to 15 units of high-school work, will be found in detail in the University Register.

The College of Law requires, in addition to 15 units of high-school credit, two years (60 semester hours) of college work in arts, letters, and science in an institution having standards equal to those of the University of Illinois.

The Library School requires a bachelor's degree in arts, letters, or science from an institution having standards equal to those of the University of Illinois.

The College of Medicine (Chicago) requires, in addition to 15 units of high-school credit, two years (60 semester hours) of college work in an institution having standards equal to those of the University of Illinois.

The College of Dentistry (Chicago) requires an applicant for admission to present a certificate of graduation from an accredited high school or the equivalent; which equivalent is interpreted to mean 15 units of preparatory work in an accredited high school or academy or a state normal school.

The School of Pharmacy (Chicago), for the year 1915-16, requires for admission to its shorter course, leading to the degree of Graduate in Pharmacy, two years of high-school work or the full educational equivalent; and for admission to its longer course, leading to the degree of Pharmaceutical Chemist, graduation from an accredited high school or the equivalent. For the year 1916-17 and thereafter, graduation from an accredited high school with 15 acceptable units will be required for admission to both courses in this school.

ENTRANCE REQUIREMENTS OF THE UNDERGRADUATE COLLEGES

Under an action taken by the Board of Trustees of the University of Illinois on June 9, 1914, the following new entrance requirements for the courses leading

to the degrees of Bachelor of Arts, Bachelor of Science, and Bachelor of Music—or, in other words, for the undergraduate departments at Urbana, including the College of Liberal Arts and Sciences, the College of Engineering, the College of Agriculture, and the School of Music—go into effect September 1, 1915:

HIGH SCHOOL GRADUATION

A candidate for admission *by certificate* must be a *graduate* of an accredited high school or other accredited school.

An applicant who has not been graduated from an accredited school must pass entrance examinations in the following subjects, amounting to 7 units*:

English composition	1 unit
English literature	2 units
Algebra (to quadratics)	1 unit
Additional subjects to be designated by the University authorities	3 units
Total	7 units

The remaining 8 units necessary to make up the 15 units required for admission may also be made in entrance examinations or may be offered by certificate from any accredited school.

NUMBER OF UNITS REQUIRED

Fifteen units of high-school or other secondary-school work, in acceptable subjects (see Lists A, B, and C below), must be offered by every candidate.

For 1915-16 students may be admitted with conditions of not more than *one unit;* that is, with a minimum of 14 units. All such conditions must be made up before the student can be permitted to register for his second year in the University.

A conditioned student is not matriculated and must pay a tuition of $7.50 a semester in addition to the regular incidental fee of $12.00 a semester.

No student having entrance conditions may register for a second year in the University, except on the recommendation of the faculty of the college or school in which he is enrolled, approved by the Council of Administration. Only in rare and especially meritorious cases will such permission to continue as a conditioned student be granted.

After September 1, 1916, no conditions will be permitted. In other words, every student must offer at the time of admission 15 units in acceptable subjects, including the 6 units specifically prescribed for all the undergraduate colleges (see List A below). It is provided, however, that a student who offers 15 acceptable units including the 6 units of List A, but is deficient not to exceed 2 units in subjects prescribed only for the college or curriculum which he wishes to enter, may be admitted in that college or curriculum to courses for which he is fully prepared, subject to the requirement that the deficiencies in question shall be removed before he may register for a second year's work.

*A unit is the amount of work represented by the pursuit of one preparatory subject, with the equivalent of five forty-minute recitations a week, through 36 weeks; or, in other words, the work of 180 recitation periods of forty minutes each, or the equivalent in laboratory or other practise.

PRESCRIBED SUBJECTS

SUMMARY

The 15 units offered for admission must include:

I.	Certain subjects *prescribed alike for all courses* (see List A below)	6 units
II.	Certain subjects *prescribed in addition for the individual course* which the student wishes to enter	1 to 4 units
III.	Enough *electives in academic subjects* (see List B below) to make, with the subjects prescribed for all courses (List A) and those prescribed for the individual course of the student's choice, 12 units in academic subjects	5 to 2 units
IV.	*Three additional units*, which may be chosen either from the list of Academic Electives (List B) or from the list of Additional Electives (List C)	3 units
	Total	15 units

LIST A

English (composition and literature)	3 units
Algebra	1 unit
Plane geometry	1 unit
Physics, or chemistry, or botany, or zoology, or physiology, with laboratory work	1 unit
Total	6 units

LIST B

		Units
Latin	36 to 144 weeks	1-4
Greek	36 to 108 weeks	1-3
French	36 to 144 weeks	1-4
German	36 to 144 weeks	1-4
Spanish	36 to 144 weeks	1-4
English (4th unit)	36 weeks	1
Advanced algebra	18 weeks	½
Solid geometry	18 weeks	½
Trigonometry	18 weeks	½
History	36 to 108 weeks	1-3
Civics	18 or 36 weeks	½-1
Economics and economic history	18 or 36 weeks	½-1
Commercial geography	18 to 36 weeks	½-1
Astronomy	18 weeks	½
Geology	18 or 36 weeks	½-1
Physiography	18 or 36 weeks	½-1
Physiology	18 or 36 weeks	½-1
Zoology	18 or 36 weeks	½-1
Botany	18 or 36 weeks	½-1
Physics	36 to 72 weeks	1-2
Chemistry	36 to 72 weeks	1-2

LIST C

Agriculture	36 to 72 weeks	1-2
Bookkeeping	36 weeks	1
Business law	18 weeks	½
Domestic science	36 to 72 weeks	1-2
Drawing, art and design	18 or 36 weeks	½-1
Drawing, mechanical	18 or 36 weeks	½-1
Manual training	36 to 72 weeks	1-2
Music	36 to 72 weeks	1-2

For more complete details as to entrance requirements see the University Register, a copy of which may be had, on request, from the Registrar.

II

UNDERGRADUATE SCHOLARSHIPS

(For circulars giving more detailed information concerning these scholarships, apply to the Registrar of the University.)

COUNTY SCHOLARSHIPS

A law passed by the General Assembly of the State of Illinois at the session of 1905 and embodied in the General School Law of 1909 provides that one scholarship may be awarded annually to each county of the State. The holder thereof must be at least sixteen years of age, and a resident of the county to which he is accredited. No student who has attended the University of Illinois is eligible for a scholarship. The holder of a scholarship is relieved of payment of the matriculation fee ($10.00, payable once, upon entrance) and incidental fees for four years ($24.00 a year) in any department of the University other than the professional school. The term "professional schools," as here used, includes the College of Law, the Library School, the College of Medicine, the College of Dentistry, and the School of Pharmacy.

A competitive examination, under the direction of the President of the University, and upon such branches of study as the President may select, is held, upon the first Saturday in June of each year, at the county court house in each county by the County Superintendent of Schools. Questions for the examinations are furnished in advance to the County Superintendents.

The successful candidates in the examinations must then meet in full, either by certificate from an accredited high school or by passing entrance examinations at the University, the requirements for admission to the freshman class, and must register the following September.

In case the scholarship in any county is not claimed by a resident of that county, the President of the University may fill the same by assigning to that county from some other county the student found to possess the next highest qualifications.

A student holding a scholarship who shall make it appear to the satisfaction of the President of the University that he requires leave of absence for the purpose of earning funds to defray his expenses while in attendance, may, in the discretion of the President, be granted such a leave of absence, and may be allowed an extension of his scholarship for not more than two years (making not more than six years in all from the beginning of the scholarship). Such extension will not be granted unless the student has been in attendance at the University for at least one full semester, nor unless the student's average grade during the period of his attendance has been at least 80 per cent, exclusive of grades in military science and physical training.

GENERAL ASSEMBLY SCHOLARSHIPS

The same act by which the county scholarships described above were established also provides that each member of the General Assembly may nominate annually one eligible person from his district for a scholarship in the University, granting the same privileges as the county scholarships.

A member of the General Assembly who wishes to nominate a candidate for a scholarship should file the name and address of his nominee as early in the spring as practicable and not later than June 1, with the President of the University and also with the County Superintendent of the county in which the nominee resides.

The nominee is then required, under the statute, (1) to pass the scholarship examination—the same that is given to competitors for the county scholarships on the first Saturday in June, under the County Superintendent; (2) to meet in full, either by certificate from an accredited high school or by passing entrance examinations at the University, the requirements for admission to the freshman class; and (3) to register in the University the following September.

If a nominee fails to make a passing grade (70) in the scholarship examination he may not receive the scholarship. In this case notice will be sent to the member of the General Assembly who made the nomination, who is then entitled to nominate a second candidate. This second candidate is subject to all the requirements stated above; the scholarship examination will be given him at the University on the Wednesday preceding the fall registration days (in 1915, September 15).

A General Assembly scholarship may be extended under the same conditions as a county scholarship.

SCHOLARSHIPS IN CERAMICS

The University offers annually to each county in the State one scholarship, awarded by the Trustees of the University, upon the nomination of the Illinois Clay Workers' Association, to applicants who intend to pursue either of the courses in ceramics (Ceramics, and Ceramic Engineering). These scholarships are good for four years and relieve the student from the payment of the matriculation fee ($10.00, payable once, upon entrance) and the incidental fees ($24.00 a year).

The candidate must be at least sixteen years of age, must be a resident of the county for which he is nominated, and must meet *in full, before entering,* by certificate from an accredited high school or by passing entrance examinations at the University, the requirements for admission to the freshman class.

SCHOLARSHIPS IN AGRICULTURE AND HOUSEHOLD SCIENCE

The University offers every year to each county in the State, except Cook and Lake, and to each of the first ten congressional districts, one scholarship for prospective students of agriculture in the College of Agriculture and one for prospective students of household science in the College of Liberal Arts and Sciences or the College of Agriculture.

Appointments to scholarships in agriculture are made by the Trustees of the University upon the recommendation of the Executive Committee of the Illinois Farmers' Institute; and to scholarships in household science upon the recommendation of the County Domestic Science Associations, or, for counties and districts in which there are no domestic science associations, on the recommendation of the Illinois Farmers' Institute. Persons who have already attended the University are not eligible.

Candidates who are able to meet in full the requirements for admission to the freshman class are eligible to appointment at 16 years of age. Candidates who cannot meet these entrance requirements are eligible to appointment as special students (in the College of Agriculture) at 21 years of age.

Acceptable candidates, residents of counties or districts for which appointments have been made, not exceeding five in number from any one county or district, may be assigned to counties or districts for which no recommendations are made. The first nominee from each county or district, if duly qualified, is awarded the scholarship at the time of registration. Other nominees must pay the regular fees on registration. Assignments to counties and districts for which there are no nominees registered are made on October 15, at which time the nominees so assigned to counties or districts other than their own receive rebates of the full amount of the matriculation and incidental fees paid.

The scholarships are good for two years and relieve the holders from the payment of the matriculation fee ($10.00, payable once, upon matriculation), and the incidental fees ($24.00 a year). If, before a scholarship expires, the holder satisfies in full the requirements for admission to the frehman class of the college in which he or she is enrolled the term of the scholarship may be extended to four years from the date of the student's matriculation.

MILITARY SCHOLARSHIPS

Students who have had three semesters of class instruction in military science and four semesters of drill practise are eligible for appointment as commissioned officers of the University Corps of Cadets. To those attaining this rank, special military scholarships, good for one year, and equal in value to the university incidental fees for the year, are open. The amount of these scholarships is paid to the holders at the close of the academic year. Appointments in the Corps of Cadets are made on the recommendation of the Commandant of Cadets, confirmed by the Council of Administration.

OTHER SCHOLARSHIPS

For scholarships in the College of Law, see page 218 of Register.

III

THE ACCREDITING OF HIGH SCHOOLS.

CONDITIONS AND METHODS.

High Schools or Academies are inspected for accrediting on application from the principal, superintendent or board of education. All applications should be made, *not later than January 30,* to the University High School Visitor. Upon receipt of such application blanks will be sent to the applicant for a full and complete report on the conditions existing in high school or academy. If it appears from this report when returned that the school is probably worthy of a place on the list of accredited schools an inspection will follow as soon as practicable.

The general conditions looked for in the preliminary report from a school are:

1. Is the length of school year at least 36 weeks (8½ calendar months or 9 twenty-day months) of actual school work?
2. Is the financial condition of the district capable of sustaining a school at such standards as will assure reasonable efficiency?
3. Are there as many as four teachers in the district below the high school?
4. Are there three or more teachers, including superintendent or principal, devoting full teaching time to high school work?
5. Are the recitation periods at least 40 minutes in length *exclusive of time required for the movement of classes?*
6. Are consecutive double periods provided for all unprepared work, such as laboratory, shop, drawing?
7. Is the material equipment of the school adequate for the work it undertakes?
8. Are text-books well chosen?
9. Are the teachers apparently well prepared for their work?
10. Do any teachers have more than seven periods per day of recitation and laboratory work?

The Visitors report the results of their inspection to the committee on accrediting of schools and this committee makes recommenda-

tion to the Council of Administration. If a school is found satisfactory a report is sent from the office of the High School Visitor together with a card on which is given a schedule of credits. Later a certificate of accrediting is sent out from the office of the University Registrar.

Accredited schools are visited at least once in three years, and oftener when deemed necessary. The University reserves the right to reconsider the accrediting of a school at any time in case of marked deterioration of work.

Each student coming to the University from an accredited high school or academy should request the principal of the school to send to the University Registrar a certificate showing the period of his membership in the high school, the fact of his graduation, the subjects he has taken in his course, the number of recitations in each subject, the length of recitations in minutes, the amount accomplished, and his average grade in each subject. For the particulars of these reports the high school principal is often obliged to depend upon records made before the commencement of his own term of service in the school, and these records should consequently be regularly kept and preserved in a way to include all the information called for by the student's certificate above described.

In the matter of accrediting special emphasis will be placed on the preparation which pupils have as a basis for promotion to the high school. The training in English, as evidenced in its use by pupils, is considered particularly important here.

We are often requested to assign credit for work done by two or three year high schools. This we can do where we have assurance through the office of the county superintendent of the county in which a school is located that a given school meets certain fundamental standards. These standards are as follows:

1. The school year must be 36 weeks of actual school work.
2. Recitation periods must be 40 minutes in length.
3. Double periods must be provided for unprepared work.
4. Adequate equipment must be provided for the courses offered.
5. The teacher or teachers should have at least two years of training beyond a standard four year high school.
6. For a two year school the full teaching time of one teacher should be required.

7. For a three year school the full teaching time of two teachers should be required.

Pupils who have had courses in such schools and who complete their work in an accredited four year high school will be accepted on certificate the same as other graduates from the same accredited schools. *The University will hereafter reserve the right to question the creditability of any four year high schools which commonly accept the work of students from two or three year high schools, without thorough examination, and which do not observe the above fundamental standards.*

High schools should not certify to work from an unaccredited school unless the pupil has had at least one year's work in the school certifying.

IV.

DESCRIPTION OF SUBJECTS WHICH MAY BE ACCREDITED AND ACCEPTED FOR ADMISSION.

The schedule of subjects accepted together with the number of units of credit which may be given to each will be found under admission requirements (see pp. 3 and 4).

In addition to the following descriptions and outlines of the various units of work acceptable for entrance reference should be made to recommendations as finally adopted by the High School Conference. These will be found published in the proceedings of the conference, a full set of which should be kept in the library of each accredited high school.

1. AGRICULTURE.

Courses in agriculture should be arranged for periods of not less than 36 weeks. Such a course may be accepted for one unit of entrance credit, and two such courses may be accepted for two units, provided the work covered by each course is so closely related in its parts as to constitute one of the generally accepted divisions now recognized in agricultural work. At least one-half the time should be devoted to laboratory work, and note-books should be presented. Seven periods of 40 minutes (two double) per week is the minimum.

In the Agricultural Section of the High School Conference, Nov. 20, 1908, the following outline of work in agriculture for secondary schools was presented:

Study of Soils

Physical composition of the soil.

Formation and transporting of soils.

Classification of soils with reference to texture.

Moisture relations of soils.

Different forms and movements of soil moisture.

Experiments to determine the percent of capillary, hygroscopic and total moisture in soils under different conditions.

Experiments to show how soils of different textures differ in their power to retain moisture and to raise it by capillary force.

Experiments to determine and to compare the percent of pore space in different soils.

Experiments to show that the capacity of soils to absorb and hold water depends upon the amount and character of the pore space.

Experiments to determine the percent of humus in soils.

Experiments to show how humus in soils affects their moisture relations.

Experiments to determine the real and apparent specific gravity of soils.

Study of temperatures of different soils.

Experiments to show effect of color on temperature of soils.

Experiments to show difference in temperature on drained and undrained soils.

Experiments to show the effect of lime on the texture of clay soils.

Experiments to show effect of organic matter on the texture of clay soils.

Study of causes, effects and control of soil erosion.

Experiments to show how soil moisture may be conserved by mulches.

Study of Plants and Crops

Study of root systems of plants and their relations to the soil.

Study of the stem and leaf in their relations to light and air.

Study of the flower in its relation to the seed and plant breeding.

Experiments in germination of seeds under different conditions of planting, temperature, heat, moisture, etc.

Experiments in soil fertility to determine essential plant foods.

Experiments to show the effect of each of the elements, nitrogen, phosphorus and potassium on plant growth.

Experiments to show effect of lime on acid soils.

Experiments to show the power of bacteria living on the roots of legumes to secure nitrogen from the air.

Special Studies in Corn

Corn judging.

Testing of seed for germination.

Care of seed.

Corn breeding.

Experiments to show power to control different characters in corn by selection of seed.

Further Courses Recommended for Schools Prepared to Give More Extended Time to the Work

Study of breeds and types of farm animals.

Study of feeds, balanced rations and principles of feeding.

Study of milk, its composition, care and testing for butter fat.

Study of the more common diseases of farm animals, their symptoms and treatments, together with their causes and means of prevention.

Study of poultry.

Judging live stock.

Improvements of animals and plants.

Study of legumes, alfalfa, clover, cowpeas and soy beans.

Study of oats, wheat and grasses.

Study of the farm garden.

Preparation and use of insecticides and fungicides.

Study of weeds, their habits of growth and dissemination and how to eradicate them.

Study of farm machinery, farm buildings and cement construction.

NOTE—For further outlines see circular on Four Years' Work in High School Agriculture, published by the College of Agriculture. Also Four Years' Course in Agriculture, recommended by the Illinois Educational Commission, Report of 1910.

See also discussions, reports and recommendations in Conference Proceedings of subsequent years.

2. ALGEBRA.

Fundamental operations, factoring, fractions, simple equations, involution, evolution, radicals, quadratic equations and equations reducible to the quadratic form, surds, theory of exponents, and the analysis and solution of problems involving these.

The following is from a syllabus of a course in algebra adopted by the Conference of 1908:

TIME AND PLACE FOR ALGEBRA IN THE HIGH SCHOOL COURSE

The best division of subject matter with reference to time is to give: first, a year of elementary algebra (first course) so arranged as to enable the pupil to solve such problems as are within his comprehension and to arouse his interest in algebra as a tool for the solution of problems which are impossible, or very difficult, by unaided arithmetic means. To this end it is highly desirable to include the treatment of quadratic equations and to omit much in the line of abstract manipulations and formal proofs. This first course in algebra should be followed by one year of plane geometry, and the two together should constitute the minimum requirement in mathematics for a high school course. This should be followed by the elective work; one-half year of algebra (second course), intended to meet the need of those pupils who desire full preparation for college and comprising a more formal treatment of the principles employed in the first course, together with advanced chapters. This should come not earlier than the first half of the third year in the high school course. Then, if given at all in the curriculum, this should be followed by one-half year of solid geometry and one-half year of trigonometry.

The early introduction of the quadratic equation in the first course enables the pupil to solve many concrete problems that appeal to him as worth while, and this is certainly much more serviceable to the pupil who takes only the required mathematics than the juggling with symbols which so often comprises a large part of the work of the first year. Furthermore, nothing seems lost to the pupil who continues algebra because of deferring the formal demonstrations and certain difficult topics and manipulations, to give time for the treatment of the quadratic equation. The study of plane geometry between the first and second courses in algebra affords a fruitful field for concrete algebraic problems, and

serves to visualize the algebra, while the plane geometry is much more concrete to the average high school pupil than the more formal parts of the second course in algebra.

Correlation Between Arithmetic and Algebra

From the start in algebra the pupil should understand that each letter or combination of letters means a number. The frequent introduction of Arabic numerals for the letters tends to make algebra real to the high school pupil. It is undesirable to attempt to draw a sharp line of distinction at any point between arithmetic and algebra. The two subjects should be closely correlated; that is, the operation of arithmetic should suggest the principles of algebra and each principle of algebra should be illustrated by numbers of the Arabic notation. All exercises involving letters should be interspersed with similar exercises involving Arabic numbers.

Illustrations of multiplication:—

45		$40+5$		$40+5$		$4a+5b$	
23		$20+3$		$20+3$		$2a+3b$	
—	or	—	or	—	or	—	
135		$120+15$		$800+100$		$8a^2+10ab$	
90		$800+100$		$120+15$		$12ab+15b^2$	
—		—		—		—	

Problems of arithmetic such as, for example, those in percentage and interest, constitute a considerable body of applications for algebraic solution during the first year. To be more specific, let us consider the problem from arithmetic, of finding the simple interest on $900 at 4 per cent for 3 years. This is given in dollars by

$$\frac{(900)\ (4)\ (3)}{100}=108$$

Next, let simple interest, principal, rate, and time in years be denoted by i, p, r, and t respectively. Then formula

$$i=\frac{prt}{100}$$

appears as a generalization of the above simple numerical case, and should be made the basis of numerous problems.

Syllabus of a First Course in Algebra. One Year

The committee does not deem it desirable to dictate an order of topics. However, in presenting the following outline, it is our purpose to suggest such an arrangement as seems to give a natural development and one suited to the needs of the pupil, both in his everyday experience and in preparing him for the elementary courses in applied science.

An explanation and discussion of significant points under each group of topics in the outline follows immediately the group of topics. The numbering

of groups in the outline and that of the discussions mutually correspond; for instance 1d contains the discussion of topics marked 1, and 2d the discussion of topics marked 2.

Outlines of topics:

1. Arithmetic problems in addition and subtraction of numbers which have a common factor; removal and insertion of parentheses, literal notation, multiplication and division of polynomials by monomials; problems leading to linear equations involving only positive integers; translating English sentences into equations and vice versa.

1 d. The purpose here is to extend the operations of arithmetic to include positive numbers represented by letters and at once to introduce the solution of simple equations and problems. Frequent translation of English into algebraic language, and vice versa, emphasizes the value of the algebraic symbol.

2. Negative numbers; addition, subtraction, multiplication and division extended to negative numbers; positive integral exponents; transposition in equations; solution of equations; verification of solutions by substitution; identities; simple simultaneous equations; graphs of simple equations; elimination by addition and subtraction; exercises and problems interspersed.

2 d. The introduction of negative numbers should be preceded by concrete illustrations to show their convenience. This can be done by reference to temperature below and above zero; credits and debits, bank deposits and withdrawals, north and south latitude, east and west longitude, opposite directions, etc. Problems yielding equations with negative solutions should next be introduced, showing need of such numbers in order to make possible the solution of the the equation involved. In general, the solution should be regarded as incomplete until the result is verified. This is both a logical and a pedagogical requirement; furthermore, this affords a most valuable exercise in the manipulation of algebraic symbols. The interpretation of results is an important part of algebra which is too much neglected. It is useful to present some problems which lead to equations which are identical in form but whose solutions lead to very different interpretations. As simple illustrations, consider the following:

a. A and B start from the same point to walk in opposite directions. At the end of one hour they are 8 miles apart, and A walks three miles farther per hour than B. How far does each of them walk?

b. Discuss the problem of finding the score in a baseball game if the sum of the runs is 8 and the difference of the runs is 3.

Both problems yield the equations:

$$x+y=8$$
$$x-y=4$$

and $x=\frac{1}{2}$, $y=2\frac{1}{2}$

satisfy these equations, but for problem b the solution has no interpretation, while in problem a it has a very definite interpretation.

The word *transpose* should not be used by the pupil in beginning the study of equations, but the process should be interpreted as the operation of addition or subtraction applied to the members of an equation.

The study of the graph in the first year is not an object in itself and should be used only in so far as it can be profitably made to throw light on the solution of problems and equations.

3. Division as the inverse of multiplication; multiplication and division of polynomials by binomials; first notion of fractions, ratio and proportion; equations involving fractional coefficients; simple problems in proportion (formal

treatment being deferred): simultaneous equations in two and three unknowns (with different methods of elimination); verification of solutions of equations by substitution; exercises and problems.

3 d. An operation and its inverse can often be taught together advantageously. This is the case with subtraction and addition, division and multiplication, root extraction and involution, factoring and special cases of multiplication. Some simple cases of proportion follow soon after division in the outline of topics. This is done in order to introduce the language of proportion in problems, but any formal treatment of proportion is deferred until near the end of the first year.

As used in the syllabus, the word "exercise" is understood to mean the formal manipulation of algebraic symbols, and the word "problem" is understood to indicate the translation of given conditions into graphic form, or into the language of the equation and the solution of the resulting equation. It is believed that about equal emphasis should be given to each.

4. Factoring—Special products and factors taught together as inverse operations; meaning of quadratic expressions and factors of such expressions; problems leading to quadratics to be solved by factoring; H. C. D. and L. C. M. by the methods of factoring; multiplication and division of polynomials by polynomials.

4 d. The early introduction of quadratics by the method of factoring affords a useful application of factoring and the solution of an important class of problems which are entirely practicable for first year pupils, but which otherwise would be postponed to the later course and so lost to a large number of students.

5. Square root; radicals of the second order and fractional exponents only so far as demanded for an elementary treatment of quadratics; approximate evaluation of numerical expressions containing radicals; exercises and problems.

5 d. Radicals and fractional exponents should be treated together with the emphasis on the latter. The manipulations which involve complicated fractional exponents belong to the later course, but some manipulations of forms involving the square root are important for the first year. The rationalization of fractions with binominal denominators and all radical expressions above the second order may well be deferred.

The object and desirability of rationalizing an expression should be thoroughly understood by the student before he does the mechanical work. To ask the student to accept $\sqrt{\frac{2}{5}}$ as a simpler form than $\sqrt{\frac{1}{5}}$ is confusing if the student does not know the purpose for which one is simpler than the other. The distinction between a rational and an irrational number should be made clear. In particular, a rational number should be defined *directly* (as a number which is equal either to an integer or to a fraction whose numerator and denominator are integers), and not negatively (as a number not involving radicals). Problems from mensuration give a meaning to radicals. For example, diagonals of squares and cubes, altitudes and areas of equilateral triangles, etc., afford abundant applications of radicals of the second order and add interest and understanding to the subject.

6. Solution of quadratics by completing the square and verification of the solution by substitution; simultaneous equations where one is linear and one quadratic, or quadratic systems of simpler forms such as $4x^2-3y^2=1$, $3x^2+4y^2=7$, $y^2=5x-4$, $2x^2+y^2=8$; exercises and problems.

6 d. The exercises and problems under this head are numerous, interesting and practical and belong properly to the first year, as is made possible by the order of topics given in this outline.

7. Fractions reduced to common denominators by factoring; addition and subtraction of fractions; multiplication and division of fractions; fractional equations with problems leading to the same; simultaneous fractional equations.

7 d. The formal treatment of fractions is deferred until near the close of the first year in order to give place to the early treatment of quadratic equations and problems. This

change does not affect the unity of the subject, since no preceding work requires operations with fractions having literal denominators.

As here used, the term "fractional equation" means an equation with the unknown appearing in the denominator. Fractional numerical coefficients should be used throughout the course.

8. Proportion and variation, formal treatment; exercises and problems.

8 d. While the language of variation may well be regarded as an antiquated form of expression for which the equation could better be substituted, yet we must prepare for the applications to the sciences in which its use is conventional; for instance, in physics it is usual to say that force varies as acceleration, rather than that force is a constant times acceleration. Proportion and variation should come in the first course in order to prepare for the solution of a large class of problems which arise in the experience of the pupil.

Topics to be Omitted from the First Year's Work

Complicated factoring; complicated complex fractions; simultaneous equations in more than three unknowns; binomial theorem; cube root, remainder theorem; imaginaries and extensive manipulations of radicals; difficult cases of simultaneous quadratics; theory of exponents, theory of quadratics; H. C. D. and L. C. M. by the method of continued division; inequalities; indeterminate equations; difficult general solutions and discussions.

Syllabus of a Second Course in Algebra. Half Year

This is the final high school course for students who wish simply full preparation for college work and should not be given earlier than the third year of the course.

Outline of Topics

1. Review of fundamental operations; manipulation of signs; simple equations; and simultaneous equations with graphs much more extensively used than in the first course.

1 d. The review implies a more critical examination than that given in the first course. The exercises and problems should be similar to those used in the first course, but not the same ones. They should be more difficult and more technical.

2. Statement of assumptions and demonstrations of theorems pertaining to fundamental operations. The effort should be to make broad assumptions which the pupil readily accepts, e. g. the commutative, distributive, and associative laws are to be assumed—not proved.

2 d. While formal demonstrations of principles are, in general, out of place in the first course, it is highly desirable that some work of this nature should be included in the second course, especially as the study of geometry has intervened and the pupil should now come to see that argumentation is not limited to geometrical theorems, but is just as important a part of algebraic work.

3. The solution of quadratics by formula; theory of quadratics; graphic work on quadratics; simultaneous quadratics, which should include the special case reducible by elimination to the solution of quadratics; exercises and problems.

3 d. It should be made clear by the instructor that the solution of a pair of simultaneous quadratics cannot, in general, be effected by quadratic methods and that only special cases are considered in this course. The graph can be made to serve a most important part at this point in interpreting geometrically the solutions.

4. Formal treatment of factoring with the factor theorem; H. C.D. and L. C. M. by the method of continued division; exercises; problems which involve factoring in the solution.

4 d. A definition of prime factor as applied to algebraic expressions is essential to determine to what extent factoring should be carried, for example: Is $x - y = (\sqrt{x} + \sqrt{y})(\sqrt{x} - \sqrt{y})$ a legitimate case of factoring in this course? The factor theorem can be made to do valuable service in solving some higher degree equations.

5. Complex fractions and fractional questions; exercises and problems.

5 d. The question of equivalent equations needs careful treatment in connection with clearing of fractions when there are literal denominators.

6. Proofs of theorems on exponents and radicals: exercises on radicals; equations and problems involving radicals.

6 d. Here as in the first course a rich field of applications may be found for radicals and radical equations, and these give life and interest to the subject which no amount of mere manipulation can afford.

7. Review and further applications of proportion and variation; binomial theorem; proof by mathematical induction for positive integral exponents; logarithms; progressions.

Many exercises and problems and much graphic work throughout the course to bring each topic close to its applications.

7. Special attention should be given to applications of the topics enumerated under this head. For instance, simple problems from physics for variation and proportion and problems in interest and annuities for logarithms.

General Remarks

No matter how good the text-book, a teacher should study carefully the adaptation of problems to his class. Problems made by the teacher and given out by him in general lend life and enthusiasm to the class work. It is of first rate importance that the problems should appeal to the pupil as raising some question whose answer is worth while. In this connection all problems which require the pupil to exercise his common sense as to the legitimacy of the result are to be commended. This is especially true of problems involving interesting data, the facts concerning which may be known from other sources.

In borrowing material from the sciences for problems, great care must be exercised lest we assume knowledge on the part of the pupil which he has assimilated. The borrowing should be from *below* rather than from *above*, or the emphasis is thrown entirely away from the point involved. In the first course arithmetic should be an important source for problems. The usual problems of interest, percentage, and proportion can well be solved by algebra. This is also decidedly true of problems presented under the name of mental arithmetic. As there should be no sharp line of distinction between arithmetic and algebra, methods which have an algebraic bearing should not be discouraged in arithmetic. The main object in this connection is to develop the pupil by generalization and it should be regarded as a good indication of progress if he early tends toward algebraic methods rather than the more special methods of arithmetic.

For the second course geometry and physics should offer a fruitful source for problems. In fact, problems of the lever and of uniform motion taken from physics may well be brought into the first year course, provided they are introduced by a careful grading up through a number of special numerical cases before a law

is stated. Literal equations should never be introduced except as a generalization after a series of special cases leading up to the generalized form. The formula is a most important feature of algebra, but it should come at the end of a well graded development and not as an abstract statement at the beginning.

Many problems can well be made to depend upon a single formula such as $s=\frac{1}{2}gt^2+at+b$ for uniformly accelerated motion. These problems may impose a large variety of conditions and lead to solutions for the various letters involved. Likewise, several problems may well be made to depend upon a single formula of geometry such as $v=\frac{1}{3}H\ (B+b+\sqrt{Bb})$ for the volume of a frustum of a cone.

Definitions should be clear and unambiguous and be introduced just where needed in the development of the subject. For example, the word "transpose" if used at all in solving equations, should not be defined as "the process of removing a term from one side of the equation to the other by changing its sign," which is entirely misleading. Again the word "cancel" if used at all, should be defined so as to indicate exactly the circumstances under which cancellation may take place, so as to avoid such ludicrous blunders as

$$\frac{3x-4}{3y+5} \quad or \quad \frac{2a+3b}{a-2c}$$

It is quite as important to drill upon the things which can not be done as upon those which can properly be done. For example $\sqrt{a+b}=\sqrt{a}+\sqrt{b}$. For this purpose nothing is so effective as the substitution of Arabic numerals for the letters.

The notion of functionality and the use of the function symbol may doubtless be introduced much earlier than is done at present. This has been advocated in a recent German report on elementary algebra. It is convenient in evaluating algebraic expressions. For example, if $F\ (a.\ b)=a^2+4ab-b^2$, to find the $F\ (2, 3)$, we have $F\ (2, 3)=2^2+4.2.3-3^2=4+24-9=19$. The committee purposely make no recommendations on this and many other forms and methods of presentation, which teachers adopt, depending upon their own training, the quality of their pupils in particular classes and the time at their disposal.

Respectfully submitted,

H. L. Rietz
H. E. Slaught
J. B. Meyer
Lewis Omer
Chas. L. Manners

Adopted at the conference November 20, 1908.

3. ASTRONOMY.

In addition to a knowledge of the descriptive matter in a good text-book, there must be some practical familiarity with the geography of the heavens, with the various celestial motions and with the positions of the conspicuous naked-eye heavenly bodies.

4. BOOKKEEPING.

The unit of work in bookkeeping for college entrance should consist of a working knowledge of both single and double entry bookkeeping for the usual lines of business. The student should be able to change his books from single to double entry and from individual to proprietorship. At least one set of transactions should be kept by single entry and at least two sets by double entry in which the uses of the ordinary bookkeeping books and commercial papers should be involved. The student should be drilled in the making of profit and loss statements and of balance sheets and should be able to explain the meanings of the items involved in both kinds of instruments. The work should be done under the immediate supervision of a teacher and the student should devote at least ten periods of not less than forty minutes full time in class each week for one academic year.

5. BOTANY.

A familiar acquaintance with the general structure of plants and of the principal organs and their functions, derived to a considerable extent from a study of the objects, is required; also a general knowledge of the main groups of plants; and the ability to classify and name the more common species. Laboratory notebooks and herbarium collections should be presented.

Following is a syllabus for Botany reported to the Biology Section of the Conference in 1913 by Professor O. W. Coldwell, chairman of a committee previously appointed, and adopted after some revision. The syllabus as revised is as follows:

1. *Previous work of the Committee.*

In the report of the committee on biology to the University of Illinois High School conference in 1911, the purposes of high school biology were outlined. Upon the basis of these purposes there was made a general statement of the content of courses in botany and zoology. In the next year a more detailed syllabus on zoology was presented and the committee was instructed to prepare a syllabus in botany.

The syllabus here presented is intentionally elastic in nature. The committee does not regard it as advisable that strictly uniform courses in botany should be given in all high schools, but thinks that the purposes of the course should be fairly uniform, though these purposes may be realized in different ways.

I. The general purposes of biology in high schools as previously outlined, are:

1) The production and conservation of a vital interest in plants and animals.

2) An appreciation of the human values of plants and animals.

3) The encouragement of the habit of raising and solving problems concerning plants and animals.

4) Some ability to use the library, the field, and the laboratory in individual pursuit of these interests.

5) The ability to sustain interest in these problems through considerable periods.

6) A sense of organic response to the environing conditions.

7) A conception of development and of the evolutionary series of plants and animals.

8) Some knowledge of living material; its organization in plants and animals; its properties and the relation of these to the activities of the organism.

9) Some experience in classification of organisms.

10) A conception of the place of man in the biological series along with convictions that this does not invalidate, but rather heightens, the meaning of the higher human qualities.

11) A sane, wholesome appreciation of the origin and meaning of sex, and its bearing on human life.

II. In addition to the above purposes botany should also present:

1) The problems of food manufacture by plants, as a basis for understanding the world's food problems—of plants, animals and men. This study of chlorophyll plants, leads to the food problem of non-chlorophyll plants, to animals, and to men. This leads to the study of types of dependency—saprophytism and parasitism. Decay and destruction of organic bodies are associated with the study of dependence.

2) Plant structures and processes are important not only in the life of plants, but also in the industries and vocations. Problems of successful plant life, and of plant productivity, and avoidance of plant diseases, etc., are topics of constant recurrence in agriculture, horticulture and gardening. Food supply, prevention of decay, the bacteria of hygiene, etc., are fundamental to household science. The fiber and timber industries depend upon structures by means of which plants do their work.

III. The following topics and approximate time distribution must be understood as suggestive, since it will often be advisable for the teacher to change the order of topics, omit or add topics, or change the relative time given to topics. No distinction is made in this outline between recitation periods and laboratory periods. It is assumed that a full year will be given to the whole course, or if but a half year, that part of the topics will be selected for use and less work be given to some of the topics selected. The arabic numbers in parentheses suggest the number of days given to the topic.

Topic 1. *Plants as universal features of the earth's surface. (1 or 2).*

A brief introductory consideration of the place of plants in nature as ordinarily observed, and of the constant daily use of plant materials. Discussion and preparation of lists to show abundance and use of plants.

Topic 2. *The plant as a machine. (2 or 3).*

A general survey of what a common plant is—roots, stem, leaves, flowers and seeds—, and a general idea of the kind of work done by each of these major divisions of a plant. Not a study of details but a unified study which gives perspective and later serves to organize the study of details. Presented by discussion, or by reading a general outline statement.

Topics 3. *Leaves (10 to 14).*

Experimentation upon the relation of leaves to food manufacture; the nature of chlorophyll; transpiration of water from the leaf; structure of leaves;

form and position of leaves; relation to lighting; deposit of food in leaves; deciduous and evergreen plants; leaves in bulbs, as tendrils and spines; propagation by leaves.

Topic 4. *Roots (6 to 8).*

Relation of roots to work of plants; roothairs; nature, extent and growth habits of roots; effects upon substratum; nature, direction and extent in wet, dry, and mesophytic regions; effects of different kinds of soils upon roots; symbiosis between roots and fungi, and bacteria; storage of food; annuals, biennials and perennials; uses for men and animals; propagation by roots.

Topic 5. *Stems (10 to 12).*

Relation of stem to chlorophyll work; kinds of stems—upright, prostrate, climbing and underground; structure; food storage; propagation by stems; roots, stems and leaves in relation to formation and holding of soils; stem, fiber and timber industries; a lumber yard; geography of forests; practice of forestry.

Topic 6. *Flowers (6 to 8).*

Relation to life of plant; organ of seed formation; parts and their names; processes of seed formation; pollination defined; variation in floral structure; acquaintance with a score of common plants by means of flowers, leaves and stems.

Topic 7. *Seeds and Fruits. (4 to 5).*

Collection of seeds and fruits; overproduction shown by calculation upon data collected from local plants; consequent struggle for existence; how seeds are scattered; seed preservation; storage of food in seeds; significance to plants and to man; fruits in relation to seeds; in relation to horticulture and agriculture; important seeds and fruits of different countries; improvement of seeds and fruits.

Topic 8. *Seedlings. (5 to 6).*

Relation to adult plant; phenomena of germination; conditions of germination; vitality of seeds; seed testing; purity of seeds.

Topic 9. *Weeds. (3 or 4).*

Weeds as illustration of struggle for existence; characteristic of successful weeds; acquaintance with a score of common weeds; weeds and crops; relation to reduction of value of seeds and crops; how to eradicate weeds; the ecology of weeds.

Topic 10. *Dependent Plants. (3 or 4).*

Dependency in relation to chlorophyll work; in relation to water supply; dependency for position as in climbing plants; decay of organic substances through action of saprophytes—molds, mushrooms, seed plants; parasitic dependents—tree-destroying fungi, corn smut, apple rust; dependent plants as causes of disease and decay, and importance of decay.

Topic 11. *The Bacteria. (5 to 7).*

Culture experiments showing distribution and growth of common forms; relation to decay and disease; relation to soils; to industries; how disease

bacteria are distributed; milk and water supply; one or two common diseases discussed in detail; local health regulations; their rationale and execution.

Topic 12. *Plants and Soils. (4 or 5).*

Different kinds of soils; kind of plants which grow on different soils; vigor of one species when grown on different soils; water retention of soils; drainage; erosion of soils; soil replenishment.

Topic 13. *Pollination. (3 or 4).*

Relation to seed formation; kinds of pollination; agencies—air and animals; study of types of common plants and text discussions; relation to breeding problems.

Topic 14. *Plant Breeding. (8 to 10).*

Pollination as basis for practice; problems involved; records of experiments; lines of promising experimentation; methods practiced; individual experiments which may be carried out.

Topic 15. *Important Plant Families. (5 or 6).*

General acquaintance with characteristics and importance of a few leading families; in the monocotyledons—the grasses, lilies and orchids; in the dicotyledons—the tree families, roses, legume, umbellifer, heath, mint, nightshade, and composite; these studied by the use of common specimens, text discussions and bulletins showing their significance.

Topic 16. *Regional Distribution of Plants. (4 or 5).*

An ecological consideration; the factors of physiographic distribution; hydrophytes, mesophytes and zerophytes; characteristic structures of plants of each type; acquaintance and interpretation of local situations.

Topic 17. *Algae. (2 to 4).*

General ideas of simple green plants, their nutrition and reproduction; one or two type specimens studied and text and class discussion of three or four types; general exhibition of marine and fresh water algae.

Topic 18. *Fungi. (8 to 10).*

The fungi already mentioned; mushrooms as types—structure, life habits, effects upon substratum; molds, review bacteria; type parasitic forms studied in detail from material, text and bulletins—as potato blight, grape mildew, wheat rust, etc., these used as basis for individual reports and class dicussions. *Lichens* are treated briefly in connection with the fungi; structure and inter-relations of two elements; distribution of lichens; effects upon substratum.

Topic 19. *Liverworts and Mosses. (3 or 4).*

General study of form, and habit of one or two thallus liverworts. Structure of a common moss; life cycle; nutrition and reproduction; life habits of mosses.

Topic 20. *Ferns. (5 to 8).*

Structure; life cycle; nutrition and reproduction; acquaintance with ten or twelve common ferns; this secured through field or laboratory study.

Topic 21. *Gymnosperms. (6 or 8).*

Pine as type; general structure of parts; how pine lives; reproduction—relation of flowers to those previously studied; the seed and its significance to the

plant; tree as factor in industry; distribution of gymnosperm forests; acquaintance with local representatives.

Topic 22. *Angiosperms. (15 to 20).*

Review previous work; monocotyledons and dicotyledons, studied by types of each; acquaintance with fifty local angiosperm plants through field observation and laboratory study; including enough identification to give method of work.

When a half-year course is presented it is suggested that the following topics be presented by very brief mention and the remaining topics presented in a less extended manner than in a full year course; 10, 12, 16, 17, 18, 19, 20, 21.

The report was accepted, and it was voted that it be considered during the next year, and brought up for final action at the next conference.

6. BUSINESS LAW.

The amount of business law which is accepted is indicated by the ground covered in any of the ordinary text-books on the subject, such as Spencer's Elements of Commercial Law, Burdick's Business Law, and White's Elements of Commercial Law.

7. CHEMISTRY.

The instruction must include both text-book and laboratory work. The work should be so arranged that at least one-half of the time shall be given to the laboratory. The course as it is given in the best high schools in one year will satisfy the requirements of the University for the one unit for admission. The laboratory notes, bearing the teacher's indorsement, must be presented as evidence of the actual laboratory work accomplished. Candidates for admission may be required to demonstrate their ability by laboratory tests.

Following is a revised copy of an "Outline of Experimental Work in Chemistry" as reported to the High School Conference November 24, 1911:

1. Physical and Chemical Changes.

The experiments suggested in any of the manuals in the reference list, or in the text used.

2. The Production of Chemical Changes.

a. Heat. Heat sugar in an evaporating dish.
b. Electricity. Electro-plating with copper. (Instructor)
c. Light. Expose blue print paper to light.
d. Trituration. Rub together mercury and iodine in a mortar.
e. Solution. (1) Mix baking soda and tartaric acid, both dry.
(2) Dissolve baking soda and tartaric acid separately in water and then mix the solutions.

3. Mixture and Compounds.

4. Oxygen.

a. Preparation of oxygen.
   (1) By heating mercuric oxide.
   (2) By heating mixture of potassium chlorate and manganese dioxide.
b. Properties of oxygen.
   Color, taste, smell.
c. Chemical behavior.
   (1) At ordinary temperature on charcoal, sulphur and phosphorus.
   (2) At higher temperature on charcoal, sulphur, phosphorus, iron wire or watch spring.
   (3) Oxidation of all types.
   (4) Combustion.
   (5) Role of oxygen in life.
   (6) Ozone.
d. Weight of a liter of oxygen. (Instructor)
e. Chemical Equations "begun".

5. Hydrogen.

a. Preparation of hydrogen.
   (1) By electrolysis (Instructor)
   (2) By action of sodium on water.
   (3) By action of zinc and iron on dilute hydrochloric and sulphuric acids.
   (4) By action of zinc and iron on acetic acid. (Instructor)
b. Properties.
   (1) Color, odor, taste.
   (2) Weight as compared with air. Leave bottle of hydrogen uncovered. Pour hydrogen upward from one vessel to another. (Fill soap bubbles or small toy balloons with hydrogen.) (Instructor)
   (3) Diffusion. Occlusion.
c. Kinetic theory of gases reviewed and extended.
d. Chemical behavior.
   Burning of hydrogen; heat of flame; color of flame.

6. Water.

a. Occurrence of water in wood.
b. Hydrates.
   (1) Heat crystals of copper sulphate; when white, treat with drop of water—Taste? Solubility?
   (2) Heat alum on iron plate as in (1).
   (3) (a) Treat washing soda crystals as in (1)
   (b) Exhibit and interpret crystals of various substances that are partially dehydrated. (Instructor)
c. Efflorescence of sodium sulphate.
d. Deliquescence of calcium chloride.

e. Vapor tension reviewed or taught and then expanded to include gases, liquids, and solids.

f. Vapor tension of gum camphor and moth balls used in explaining their uses.

g. Decomposition of water by electric current. Reviewed. See VL. (1)

h. Displacement of hydrogen from water by iron.

*i. Synthesis of water by means of eudiometer. (Instructor)

j. Synthesis of water by means of hydrogen and copper oxide. (Instructor)

k. Distillation of water. (Instructor)

l. Simple tests for impurities in water.

(1) Organic matter.

(2) Chlorides.

(3) Carbonates and bicarbonates.

(4) Calcium compounds.

(5) Sulphates.

m. The treating of water for industrial, sanitary, domestic, etc., purposes.

n. Solutions.

(1) Molecular theory† of solutions.
Kinetic theory further extended.

(2) Physical equilibria †† of the gaseous liquid and solid states of a substance.

7. Chlorine.

a. Preparation.

(1) Making chlorine by means of hydrochloric acid and manganese dioxide.

b. Properties of chlorine.

c. Chemical behavior of chlorine.

d. Bleaching. Commercial uses of bleaching. Commercial manufacture of bleaching powder.

e. Commercial manufacture of chlorine by the Deacon process. Liquid chlorine. Catalytic Actions. Action of Manganese Dioxide and Potassium Chlorate Reviewed. Action of Powdered Glass or Sand $KClO_3$.

f. (1) Dry steam and chlorine when heated yield hydrochloric acid and oxygen, thus 2Cl plus H_2O equals 2HCl plus O.

(2) Hat gaseous 2HCl and oxygen yield water and chlorine thus: 2HCl plus O equals H_2O plus Cl.

(1) and (2) are reversible reactions.

g. Chemical equilibrium developed.

---

*Indicates option.

†See especially "General Chemistry" by Alexander Smith; Chaps. IX & X.

††General Chemistry by Alexander Smith, pp. 115 to 127; also McFarland's Principles of Chemistry, pp. 144-154, and Richard's Industrial Water Analysis Notes for Engineers.

8. Hydrochloric Acid.

a. Preparation of hydrochloric acid from sodium chloride and sulphuric acid.
b. Properties of hydrochloric acid.
c. Chemical behavior of hydrochloric acid.
d. Commercial manufacture of hydrochloric acid.

*9. Fluorine.

*10. Hydrofluoric Acid.

a. Preparation from calcuim fluoride. Properties.
b. Etching of glass.

*11. Bromine.

Preparation from potassium bromide.
Study of properties.

*12. Hydrobromic Acid.

Action of sulphuric acid on potassium bromide.

*13. Iodine.

a. Preparation from potassium iodide.
b. Properties.
   Solubility in water, alcohol, potassium iodide solution and carbon disulphide.
c. Tinctures. Manufacture and use.
d. Effect on starch paste.
e. Displacement of iodine from potassium iodide by means of chlorine and bromine.

*14. Hydriodic Acid.

Action of sulphuric acid on potassium iodide.

15. Acids Bases and Salts. Ionization.

Effects of ionogens upon the boiling point and freezing point. Upon osmotic pressure. Molecular weight. Use of theory in calculations.
Modern methods of making water analyses.

a. Test distilled water: (1) as to taste, (2) action on litmus, (3) conductivity.
b. Repeat 1, 2, 3 of a, using solution of sodium hydroxid (Caustic soda). Try its solution effect on solution of ferric chlorid. A substance which in solution has such action is called a BASE.
c. Repeat 1, 2, 3 of a, using solution of hydrogen chlorid (Hydrochloric acid). Try its action on baking soda. A substance whose solution gives such effects is an *ACID*.
d. To 5cc. sodium hydroxid solution add hydrochloric acid drop by drop with constant stirring till a strip of litmus suspended in the solution is just violet in color. Evaporate to dryness, moisten with water and dry again. Repeat b and c using solution of this solid. Such a substance is a *SALT* and the process by which it is obtained is NEUTRALIZATION.

16. Valence.
17. Knowledge of Chemical Equations extended.
18. Neutralization.
19. Law of Definite Proportions.
20. Law of Multiple Proportions.
21 Law of equivalent proportions.

22. Avogadros Hypothesis.

23. The Atmosphere.

a. Proportion of oxygen and nitrogen by the phosphorus method.
b. Proportion of O and N by the pyrogallic acid method.
c. Presence of water vapor by means of calcium chloride.
d. Presence of carbon dioxide by means of lime water. Ventilation. Recent researches on effect of CO_2.
e. Weight of liter of air. (Instructor)
f. Dust in the air.
g. Atmospheric pressure.
h. Humidity and health.
i. Biology and physiography of the air, touching especially c, d, f, and h.
*j. The rare elements of the atmosphere. Argon, helium.
For several good experiments, see various H. S. manuals in Physiography. krypton, neon, xenon.
k. Liquid Air, Low temperatures. Commercial preparation of liquid oxygen.
l. Study of the element, nitrogen.

24. Ammonia.

a. Preparation of ammonia:—
By means of ammonia chloride and calcium hydroxide.
b. Properties.
c. Chemical behavior:
d. Artificial refrigeration.
(1) Freeze water surrounding a test tube containing ether which is vaporized by pumping through the same a stream of air by means of a bicycle pump.
Effects of the reduction of pressure upon a gas reviewed and expanded. Critical temperature and pressure.
(2) Evaporate ether in a watch glass immersed in water by placing same under receiver of an air pump and exhausting the air.

25. Nitric Acid.

a. Preparation of nitric acid from sodium nitrate.
b. Chemical behavior of nitric acid.
c. Solubility of nitrates.
d. Reduction of nitric acid by means of nascent hydrogen and formation of ammonia.
e. The manufacture of nitric acid and nitrates by means of electricity.

26. Nitrification.

Soil bacteria. Commercial methods in use.

27. Oxides of Nitrogen.

*a. (1.) Preparation of nitrous oxide ammonuium nitrate. Properties of nitrous oxide. (Instructor)

(2). The production of anaesthesia. Modern methods in use in surgery and dentistry.

b: Preparation of nitric oxides by means of copper and nitric acid. Properties of nitric oxide.

c. (1.) Preparation of nitrogen peroxide from nitric oxide by contact with air.

(2.) Formation of NO_2 from NO by contact with the air at ordinary temperatures. The formation of N_2O_4 from NO_2 at lower temperatures. Conditions of dissociation. Equilibrium equations.

28. Phosphorus.

a. Examination and comparison of waxy phosphorus and red phosphorus.
b. Action of phosphorus and iodine.
c. Preparation of phosphine. (Instructor)

29. Arsenic.

a. Examination of the element. Examination of arsenic trioxide. Reduction of arsenic trioxide.
b. Preparation of arsine and decomposition by heat. Marsh's test for arsenic.
c. Insecticides and fungicides.

*30. Antimony.

a. Properties.
b. Preparation of stibing. Comparison with arsine.

*31. Bismuth.

a. Properties.
34. Periodic Grouping Discussed. See references under Periodic Law.

32. Sulphur.

a. Properties.
(1) Examinations of roll sulphur.
(2) Preparation and examination of amorphous sulphur by distillation of sulphur and condensing in a beaker of cold water.
(3) Preparation and examination of monoclinic sulphur by cooling molten sulphur in a crucible.
(4) Preparation and examination of rhombic crystals of sulphur by decomposition from carbon disulphide solution. (Instructor)
b. Chemical behavior of sulphur. Action of heated sulphur upon iron filings and copper foil. Formation of sulphur dioxide by burning.

33. Hydrogen Sulphide.

a. Preparation from ferrous sulphide.
b. Properties: Solubility in water, combustion. Use of hydrogen sulphide as a precipitant of metals from solution.

34. Sulphur Dioxide.

a. Preparation.
   (1) By burning sulphur.
   (2) By action of copper upon sulphuric acid. (Instructor)
   (3) By action of sulphuric acid upon sodium sulphite.

   Properties: Color, odor, solubility in water, action of solution toward litmus, bleaching power.

*35 Sulphur Trioxide.

Preparation by passing sulphur dioxide and air over platinized asbestos. (Instructor.)

36. Sulphuric Acid.

a. Preparation from sulphur trioxide. (Instructor)
*b. Preparation by lead chamber process. (Instructor)
c. Commercial manufacture of sulphuric acid by the contact process. Catalytic action reviewed and expanded.
d. Properties of sulphuric acid.

*37. Additional Theory.

a. Molecular masses.
   (1) Vapor density methods.
   (2) Osmotic pressure methods.
   (3) Boiling point and freezing point methods.
b. Atomic masses.
   (1) Exact atomic masses.
   (2) Law of Dulong and Petit.
   (3) Determination of formula of a compound.
c. Laws of Simple and multiple Volumes.
d. Thermochemistry.
   (1) Law of Dulong and Petit reviewed.
   (2) Definition of units.
   (3) Heat of formation.
   (4) Heat of reaction.
   (5) Typical exothermic and endothermic reactions.

38. Carbon.

a. Use of charcoal or boneblack as filters.
b. Action of oxygen upon heated carbon; showing the formation of carbon dioxide by its action on lime water.
c. Reduction of copper oxide by means of charcoal.

39. Carbon Dioxide.

a. Show presence of carbon dioxide in breath by means of lime water.
b. Liberation of carbon dioxide from carbonates by means of acids.
c. Properties of carbon dioxide:
   Color, odor, taste, weight as compared with air, effect upon flame or spark, action of carbon dioxide upon caustic potash or lime water. Show how presence of carbon dioxide in water causes calcium carbonate to dissolve.
d. Decomposition of carbon dioxide by burning magensium.
e. Oxidation of powdered charcoal by means of potassium nitrate.

40. Carbon Monoxide.

a. Preparation of carbon monoxide from oxalic acid.
b. Properties: Burning carbon monoxide. Reduction of copper oxide by carbon monoxide.

44. Additional Compounds of Carbon.

a. Acetylene, etc.
b. Soaps.
c. Alcohols.

41. Study of Flames.

a. Flame produced by jet of illuminating gas in atmosphere of air or oxygen. (Flame produced by jet of oxygen in atmosphere of illuminating gas. Instructor)
b. Kindling temperature of gases. (Instructor)
   (1) Try lighting gas by means of hot wire estimating kindling temperature by shade of wire which will ignite flame.
   (2) Cooling effect of wire gauze on burning gas.
   Application to safety lamp.
c. Structure of flame. Reduction of oxides and oxidation of metals by means of blow pipe.

*42. Boron.

Preparation of boric acid from borax. Flame test. Borax beads.

43. Silicon.

a. Preparation of silicic acid. Water glass.
b. The manufacture of glass. The kinds of glass.
c. The manufacture of carborundum.

*44. Lithium.

45. Sodium.

a. Examination of piece of sodium, action of air upon it, action of sodium upon water reviewed.
b. Electrolytic preparation of sodium hydroxide.

c. The commercial manufacture of sodium carbonate and sodium bi-carbonate. Uses in the arts and in daily life.
d. Sodium in agriculture.
e. Sodium amalgam.

46. Potassium.

a. Examination of piece of potassium; action of air upon it; action of potassium upon water. (Instructor.)
b. Extraction of potassium carbonate from wood ashes.
c. Manufacture of potassium hydroxide from potassium carbonate.
d. Potassium in the industries and in daily life.
e. The manufacture of fertilizers by electrical methods.

47. Ammonium.

a. Preparation of ammonium amalgam from sodium amalgam and ammonium chloride.
b. Theories of classification of ammonium based upon experimental evidence in (a) and in references cited.

48. Test for Alkali Metals.

a. Action of alkalies on ammonium salts reviewed.
b. Detection of members af alkali group by means of flame tests.

49. The Periodic Law. Study of Curves. Their Significance. Recent Investigations.

References: Newth's Inorganic Chemistry; Alex Smith's General Chemistry; Remsen's College Chemistry; Hessler & Smith's Essentials of Chemistry; Dobbin & Walker's Chemical Theory; Venable's Rise and Development of the Periodic Law; Mendelejeff's Principles of Chemistry; Science—June 29, 1900, July 6, 1900, Nov. 10, 1911.

50. Calcium Group.

a. Preparation of calcium chloride from limestone.
b. Preparation of lime from limestone.
c. Slaking lime—manufacture of lime water; use of lime water to detect carbon dioxide.
d. Manufacture of Plaster of Paris from Gypsum; uses of Plaster of Paris.
e. Preparation of Calcium Carbide.
f. Cements. The cement industry. Mortar.
g. Test for calcium by formation of calcium oxalate in solutions.
h. Flame reactions of barium, strontium and calcium.
i. Comparison of the elements of the calcium group and their compounds.

51. Magnesium.

a. Examination of magnesium.
b. Burning of magnesium.
c. Citrate of magnesium. Uses.

d. Commercial uses illustrated in face powder, pipe covering, electric fuses, etc.
e. Test of magnesium.
f. Preparation of compounds of magnesium from magnesite.

52. Zinc.

a. Examination of zinc.
b. Action under blow pipe.
c. Study of paints.
d. Action with acids reviewed.
e. The formation of zincates. Explained by ionic theory.

53. Copper.

a. Examination of copper.
b. Action with acids.
c. The preparation of copper nitrate.
d. Displacement of copper from its compounds by zinc and iron.
e. Precipitation of copper sulphide by means of hydrogen sulphide.
f. The refining of copper by electrolytic deposition.
g. Oxidized copper.
h. Alloys.
i. Hydrates.
j. Flame tests.
k. Cuprous compounds.
l. Insecticides and fungicides.

54. Mercury.

a. Examination of mercury.
b. Action with acids.
c. Mercurous and mercuric compounds.
d. Amalgams. Use in electrical work.
e. Preparation of Nessler's solution by the student. Uses.

55. Silver.

a. Examination of silver.
b. Preparation of silver nitrate from a ten cent piece.
c. Formation of silver chloride in solution. Action of light upon halogen compounds of silver. Photography.
d. Reduction of silver chloride by means of zinc and dilute sulphuric acid.
e. Action of silver under blow pipe.
f. Common industrial processes for the preparation of silver.

56. Aluminum.

a. Study of aluminum.
b. Action with acids and alkalies.
c. Precipitation of aluminum hydroxide. Sodium aluminate.

d. Testing of alums for ammonium and potassium.
e. Make alum from clay.
f. Mordants and lakes. Dyeing.
g. Electrolytic preparation of aluminum.
h. The ceramic industries.
l. Domestic uses of the metal.
j. The glass industry reviewed and additional processes studied.
k. Ceramics.

57. Lead.

a. Examination of lead.
b. Action with acids.
c. Action under blow pipe.
d. Action of nitric acid on red lead (minium). Action of red lead under blow pipe.
e. A comparative study of the oxides of lead.
f. A study of the carbonate in paints.
g. Ionic studies of lead.
   (1) In storage batteries.
   (2) Action of water on lead pipes. Pitting of boilers.
   (3) Electrolytic action on pipes.
h. *Optional.* The paint industry.

58. Tin.

a. Examination of tin.
b. Action with acids.
c. Reduction of mercuric chloride by stannous chloride.
d. Tin salts as mordants. Lakes.

59. Iron.

a. Examination of iron.
b. Action of iron with acids.
c. Change of ferrous compounds to ferric compounds and conversely.
d. Commercial methods of preventing corrosion. Bower's Barff process.
e. The industrial preparation of iron. Vanadium steel. Tungsten steel.

*60 Manganese.

Reduction of potassium permanganate by means of ferrous sulphate.

*61. Chromium.

a. Action of acids on chromates and alkalies on dichromates.
b. Use of chromium compounds in dyeing.
c. Pigments.

*62. Gold.

a. Properties of gold.
b. Action with acids. Solution in aqua regia.
c. Test for gold. Reduction with stannous chloride and formation of purple of Cassius.

NOTE.—For Household Chemistry the teacher is referred to University Bulletin No. 24 (Feb. 9, 1914).

8. CIVICS.

Such an amount of study of the American Government, its history and interpretation, as is indicated by any of the usual high-school text-books on civil government, is regarded as sufficient for one term. The work may advantageously be combined with the elements of political economy.

9. COMMERCIAL GEOGRAPHY.

The amount and character of the work accepted in this subject is indicated by the scope of such books as Redway's Commercial Geography, Adam's smaller book on the same subject, the text-books of Brigham, or Robinson, or Trotter's work.

10. DOMESTIC SCIENCE.

(a) An equivalent of 180 hours of prepared work with at least two recitation periods a week in foods. (b) An equivalent of 180 hours of prepared work with at least one recitation period a week in clothing. (c) An equivalent of 180 hours of prepared work with at least two recitation periods a week on the home. (Two periods of laboratory work are considered equivalent to one period of prepared work.) Of the foregoing, (a) will be accepted as a unit's work; or two half units from (a) and (b), or (a) and (c), or (b) and (c) will be accepted as a unit's work. The work is to be done by trained teachers with individual equipment, as determined by inspection.

For a more detailed outline of courses see Syllabus of Domestic Science and Domestic Art for the High Schools of Illinois (University Bulletin No. 24, Feb. 1914). This is the syllabus revised and adopted by the Domestic Science Section of the High School Conference November, 1910, and is the approved basis for accrediting high school work in this department.

11. DRAWING.

Free-hand or mechanical drawing, or both. Plates or drawing books must be presented where entrance is on examination. The number of credits allowed depends on the quantity and quality of work done.

Following is a course in outline for free-hand drawing as approved by the Manual Arts Section of the High School Conference, November, 1910:

Basis for credit—1 Unit—240 Hours.

Approximately one-third of the time should be given to representative drawing and two-thirds to decorative composition, design, constructive design and crafts work.

First Year

1. Pictorial—
   - Plant Study—Flowers, sprays of leaves, seed pods, etc., in full values of light, shade and color.
   - Object Study—Furniture, interiors, etc. Perspective, scientific apparatus, vase forms, common objects.
   - Mediums—Pencil, charcoal, colored crayons, water color, pen and ink.

2. Decorative Composition—Two values.
   Plant forms, object study.
   Plant analysis (for purposes of design.)
   Mediums—Pencil, brush, ink, charcoal.
3. Design—(Space divisions, conventionalized plant forms.)
   Decorative units, borders, surfaces, illustrating balance and rhythm.
   Arrangements of straight lines (tile designs).
   Collection of insect and plant forms to be used as motives for design.
   Mediums—Pencil, brush, ink, water color, charcoal.
4. Constructive Design—
   Designs for tiles, candlesticks, tea caddies, nut bowls.
   Decorations inlaid and incised.
5. Craft—
   Pottery, to be finished in biscuit or glaze.
6. Lecture Course—
   Utility—Practical talks on the fitness for service and beauty of decoration in the common objects for home use. Streets attractive and ugly.
   Beauty—Study of Greek life—spirit of the people—vase forms, their proportion and decoration.

SECOND YEAR

1. Pictorial—
   Plant Study—Still life—Landscape—Pose—Scientific Apparatus.
   Mediums—Pencil, charcoal, brush and ink, colored crayons, water color.
2. Decorative Composition—Three values.
   Plant Study—Landscape—Pose—Scientific Apparatus, used for decorative effects in covers, etc.
   Plant analysis—(For purposes of design.)
3. Design—(Conventionalized plant forms.)
   Intensity scales.
   Color balance.
   Decorative arrangements for wall papers, etc.
   Conjugated arrangements of lines, straight and curved, in borders, corners, surfaces, repeats.
   Color schemes for interior decoration.
   Lettering and illuminating.
4. Constructive Design—
   Designs for mats, card cases, pocket books, book covers, large table or lamp mats.
5. Craft—
   Embossed leather, ooze leather, colored.
   Mediums—Oil colors and gasoline, Easy dye.
6. Lecture Course—
   Utility and beauty: Interior decoration, wall decoration and spacing.
   Arrangement of furniture for center of interest and harmony of effect.
   History: Historic Ornament, Egyptian, Greek, Roman, Moorish, Byzantine, Gothic, Renaissance.

Third Year

1. Pictorial—
   Plant study—Cast drawing in three tones—Still life—(Reference to College requirements.)
   Post drawing—Landscape.
   Mediums—Pencil, water color, charcoal.
2. Decorative Composition—
   Plant forms—Pose—Landscape.
   Mediums—Ink, water color, charcoal.
3. Design—
   Accidental confusion of colors brought into harmony.
   Study of Japanese prints.
   Schemes of color for interior decoration.
   Plans for a school park or play ground.
4. Constructive Design—
   Designs for a belt buckle, watch fob, ink pot, lantern.
5. Craft—
   Copper, etched or decorated with enameling.
6. Lecture Course—
   Utility and beauty; Discussion of landscape and civic architecture of the immediate neighborhood.
   History: History of Painting; Italian, Spanish, Dutch, Flemish.

Fourth Year

1. Pictorial—
   Antique casts—Composition from famous masters.
   Pose Drawing—Landscape.
   Mediums—Water color, charcoal.
2. Decorative Composition—
   Landscape.
   Mediums—Water color, charcoal.
3. Design—
   Color harmony by interchange.
   Colors of semi-precious stones and their use in design.
   Rythmic measures and proportions in Architecture.
   Planning of the rooms of a house with samples of curtains, carpets, wall papers if possible.
   Medium—Designers' Colors, pencil, pen and ink, water colors.
4. Constructive Design—
   Designs for scarf pins, rings, cuff links, etc.
5. Craft—
   Silver with simple pierced decorations and semi-precious stones.
6. Lecture Course—
   Utility and Beauty: Handicrafts of the present century.
   History: History of Painting; German, French, English and American.
   Ethics: Imitation in furniture, etc. What principles are involved in the present craftsman movement.

Note.—Instrumental drawing to be given as needed to meet requirements of practical designing and construction. Book binding, furniture construction, wood block printing (decorative composition in landscape, figure study, plant study, etc.) may be substituted for one year of any craft. Stenciling to be given in connection with design if there is sufficient time.

12. ECONOMICS.

The principles of economics, with economic history, as given in any good elementary text-book.

13. ENGLISH COMPOSITION AND RHETORIC.

Correct spelling, capitalization, punctuation, paragraphing, idiom, and definition; the elements of rhetoric. The candidate will be required to write two paragraphs of about one hundred fifty words each to test his ability to use the English language. This work counts for one unit.

14. ENGLISH LITERATURE.

(a) Each candidate is expected to have read certain assigned literary masterpieces, and will be subjected to such an examination as will determine whether or not he has done so. With a view to a large freedom of choice, the books provided for reading are arranged in the following groups, from which at least ten units are to be selected, two from each group. Each unit is here set off by semicolons.

I. The Old Testament, comprising at least the chief narrative episodes in Genesis, Exodus, Joshua, Judges, Samuel, Kings, and Daniel, together with the books of Ruth and Esther; the Iliad, with the omission, if desired, of Books XI, XIII, XIV, XV, XVII, XXI; the Odyssey, with the omission, if desired, of Books I, II, III, IV, XV, XVI, XVII; Virgil's Aeneid. The Illiad, the Odyssey, and the Aeneid should be read in English translations of recognized literary excellence.

For any unit of this group a unit from any other group may be substituted.

II. Shakespeare's Merchant of Venice; Midsummer Night's Dream; As You Like It; Twelfth Night; Henry the Fifth; Julius Caesar.

III. Defoe's Robinson Crusoe, Part I; Goldsmith's Vicar of Wakefield; Scott's Ivanhoe or Quentin Durward; Hawthorne's House of Seven Gables; Dickens' David Copperfield or Tale of Two Cities; Thackeray's Henry Esmond; Mrs. Gaskell's Cranford; George Eliot's Silas Marner; Stevenson's Treasure Island.

IV. Bunyan's Pilgrim's Progress, Part I; The Sir Roger de Coverley Papers in the Spectator; Franklin's Autobiography (condensed); Irving's Sketch Book; Macaulay's Essays on Lord Clive and Warren Hastings; Thackeray's English Humorists; selections from Lincoln, including the two Inaugurals, the Speeches in Independence Hall and at Gettysburg, the Last Public Address, and the Letter to Horace Greeley, with a brief memoir or estimate; Parkman's Oregon Trail; either Thoreau's Walden or selection from Huxley's Lay Sermons; Stevenson's Inland Voyage and Travels with a Donkey.

V. Palgrave's Golden Treasury (First Series), Books II and III, with especial attention to Dryden, Collins, Gray, Cowper, Burns; Gray's Elegy in a Country Churchyard and Goldsmith's Deserted Village; Coleridge's Ancient

Mariner and Lowell's Vision of Sir Launfal; Scott's Lady of the Lake; Byron's Childe Harold, Canto IV, and Prisoner of Chillon; Palgrave's Golden Treasury (First Series), Book IV, with especial attention to Wordsworth, Keats, and Shelley; Poe's Raven, Longfellow's Courtship of Miles Standish, Whittier's Snow Bound; Macaulay's Lays of Ancient Rome and Arnold's Sohrab and Rustum; Tennyson's Gareth and Lynette, Lancelot and Elaine, The Passing of Arthur; Browning's Cavalier Tunes, The Lost Leader, How They Brought the Good News from Ghent to Aix, Home Thoughts from Abroad, Home Thoughts from the Sea, Incident of the French Camp, Hervé Riel, Pheidippides, My Last Duchess, Up at a Villa—Down in the City.

(b) In addition to the foregoing the candidate will be required to present a careful, systematic study, with supplementary reading, of the history of either English or American literature.

(c) The candidate will be examined on the form and substance of certain books in addition to those named under (a). For 1915 the books will be selected from the list below. The examination will be of such a character as to require a minute study of each of the works named in order to pass it successfully. The list is:

Shakespeare's Macbeth; Milton's Comus, L'Allegro, and Il Penseroso; Burke's Speech on Conciliation with America, or Washington's Farewell Address and Webster's First Bunker Hill Oration; Macaulay's Life at Johnson, or Carlyle's Essays on Burns.

The work outlined in (a), (b), and (c) counts for two units.

(d) The three units in English composition, rhetoric, and literature, as described above, are required for all students. A fourth unit may be obtained for one full year's additional work in the study of English and American authors.

SPECIAL NOTE.—*Schools receiving pupils from elementary schools where the English training is very weak may be required to give four units of work for three units of credit.*

15. FRENCH.

First year's work.—Elementary grammar, with the more common irregular verbs. Careful training in pronunciation. About 100 pages of easy prose should be read.

Second year's work.—Advanced grammar, with all the irregular verbs. Elementary composition, and conversation. About 300 pages of modern French should be read.

Third year's work.—Intermediate composition, and conversation. About 500 pages of standard authors should be read, including a few classics.

Fourth year's work.—Advanced composition, and conversation. Standard modern and classical authors should be read and studied to the extent of 700 pages.

16. GEOLOGY.

The student must show familiarity with the principles of dynamic and structural geology, and some acquaintance with the facts of historical geology as presented in Scott's Introduction to Geology, Brigham's Text-book of Geology,

or an equivalent, together with at least an equal amount of time spent in laboratory and field work. The laboratory work should follow one or more of the lines indicated below, and note-books should be presented showing the character and amount of work done. (a) Studies of natural phenomena occurring in the neighborhood which illustrate the principles of dynamic geology. Each study should include a careful drawing of the object and a written description of the way in which it was produced. (b) Studies of well-marked types of crystalline, metamorphic, and sedimentary rocks which will enable the student to recognize each type and state clearly the conditions under which it was formed. (c) Studies of minerals of economic value, including the characteristics of each, its origin, and the uses to which it is put. (d) Studies of the types of soil occurring in the neighborhood, including the origin of each and the cause of differences in appearance and fertility.

17. GEOMETRY.

Plane Geometry. Special emphasis is placed on the ability to use propositions in the solution of original numerical exercises and of supplementary theorems.

(b) *Solid and Spherical Geometry.* Applications to the solution of original exercises are emphasized.

Revised Report of the Geometry Committee
to the
High School Conference, University of Illinois
November, 1911

A. Educational Values of Elementary Geometry.

The teacher of Geometry, as well as the teacher of other subjects, should have a reason for the inclusion of his subject in the course of study. Geometry, in common with other subjects, is entitled to a place in the curriculum because of

(a) its training in logical thinking and with power to concentrate its attention,

(b) its training in exact use of language,

(c) its development of the "pictorial imagination", the ability to visualize objects, relations, and conditions,

(d) its proofs of the familiar mensuration formulas used in arithmetic,

(e) its utilitarian and practical value in the arts and sciences,

(f) the aesthetic values which its study affords.

B. Position in High School Course.

In agreement with the Algebra Syllabus adopted by this Conference (published in the High School Manual for 1909-10) the first course in Geometry should continue through the second year, following Algebra; a second elective course of one-half year should come in the second half of the third or in the fourth year.

C. Definitions, Axioms, and Assumptions.

Guiding Principles. 1. Precision in definitions should be required specially when given in student's own words. Care should be taken not to define such basal notions as, "point", "straight line", "angle", etc.

2. The first course in geometry is not a place to attempt a statement of the minimum number and of the independence of axioms. This belongs to a course in the Foundations of Geometry.

3. A free use of assumptions is recommended, yet it is essential that all propositions used explicity in a formal demonstration be recognized either as previously proved or as belonging to the list deliberately left unproved.

4. Care should be taken that such terms as "obviously", "it is self evident", "it is easily seen", etc., do not cover careless and inaccurate thinking.

5. Definitions and assumptions should be introduced when needed.

Fundamental Assumptions Listed 1. Things[1] equal to the same thing are equal to each other.

2. If equals be added to or subtracted from equals, the results are equal.

3. If equals be multiplied or divided by equals, the results are equal. (Division by zero excluded.)

4. Like powers and like positive roots of equals are equal.

5. For finite magnitudes, the whole is greater than any of its parts, and is equal to the sum of all its parts.

6. If unequals are operated on in the same way by positive equals, the results are unequal in the same order.

7. If unequals are added to unequals in the same order, the sums are unequal in the same order; if unequals are subtracted from equals the remainders are unequal in the reverse order.

8. A number may be substituted for its equal in an equation or in an inequality.

9. If the first of three numbers is greater than the second and the second is greater than the third, then the first is greater than the third.

10. A straight line may be produced to any required length.

11. Two points determine a straight line.

12. The shortest path between two points is a straight line.

13. Any figure may be moved from one place to another without altering its size or shape.

14. Through a point one line only can be drawn parallel to a line.

15. A circle may be described with any point as a center and any line segment as a radius.

*17. All straight angles are equal.

*18. All right angles are equal.

*19. From a given point in a line only one perpendicular can be drawn to the line.

*20. Equal angles have equal complements and equal supplements.

21. Circles with equal radii are equal.

*22. The sum of two adjacent angles whose sides lie in the same straight line equals a straight angle.

23. The length of a circle is greater than the perimeter of any inscribed polygon and less than the perimeter of any circumscribed polygon.

---

[1]"Things here refers to numbers which are numerical measurements of geometric magnitudes.

*The starred assumptions may be taken as theorems for informal proof or as statements of facts in the contest without special emphasis, if preferred.

24. The area of a circle is greater than the area of any inscribed polygon and less than the area of any circumscribed polygon.

*25. Two lines parallel to the same line are parallel to each other.

*26. The bisectors of vertical angles lie in a straight line.

27. A diameter bisects a circle and the surface of a circle.

28. A straight line intersects a circle at most in two points.

D. Introductory Work.

This introductory work is designed to lead the pupil gradually into demonstrative Geometry. Beginning informally, as class exercises not requiring previous outside preparations, this work should develop

(a) neatness and accuracy in drawing figures;

(b) familiarity with terms to be used in later work, as perpendicular bisector, complement, bisector, etc.;

(c) a recognition of the fallibility of the pupil's judgment, and a recognition of the necessity for logical proofs;

(d) some appreciation for the usefulness of Geometry.

Only so much of this introductory work is recommended as will carry the pupil safely over into demonstrative Geometry. Care should be taken to guard against the mistake of requiring formal demonstration of theorems which seem obvious to the pupils without proof. Introductory work may be selected from such work as the following:—

1. Problems on complementary and supplementary angles.

2. Constructing triangles when given three sides, two sides and included angle, two angles and included side.

3. Comparison of two triangles constructed with same given parts, using tracing paper or cloth, leading to the three cases of congruent triangles. Simple inaccessible distance problems.

4. Construction of perpendicular bisector of a line.

5. Drawing of perpendicular bisectors of sides of triangle, medians, and bisectors of angles.

6. Drawing of circumscribed and inscribed circle of a given triangle.

7. Drawing of a triangle, square, hexagon inscribed in a given circle.

8. Sufficient use of geometrical optical illusions.

9. Graphic proof of the Pythagorean Theorem with problems depending on it.

10. "Views" of prism, cylinder. Simple mechanical drawings.

11. Sum of angles of triangle by cutting out angles and juxtaposing; algebraic problems concerning angles of polygons, isosceles triangle, and exterior angles.

12. Angles related to parallels cut by a transversal; algebraic problems.

13. Construction of paths of points moving according to simple conditions.

It is desirable that each pupil be provided with simple and inexpensive compass, ruler in inches and centimeters, and a protractor.

---

*The starred assumptions may be taken as theorems for informal proof or as statements of facts in the contest without special emphasis, if preferred.

E. Exercises and Problems.

1. Guiding Principles. (a) The purpose of problems is to emphasize principles and theorems, and problem work is in general a means rather than an end.

(b) There should be numerous simple problems and exercises rather than a few difficult ones; there should be some oral exercises.

(c) Some exercises should come immediately after the theorems which they apply and there should be a good list at the end of chapters.

(d) Geometry should be given a concrete setting by the use of some problems from real life for the sake of clearness and interest. It is valuable to ask the students to find illustrations of abstract theorems from their own experience.

The following illustrate the meaning of concrete problems:—

(a) How high will a 40-foot ladder reach on a house if its foot is placed 5 feet from the side of the house?

(b) How could a carpenter's square be used to test whether or not a notch in the edge of a board is a true semi-circle?

(c) With only a mirror and a yard stick, how could one measure the height of a pole?

(d) Why is a step ladder made three-sided rather than four-sided?

Lists of concrete problems are available in some of the later texts and in "School Science and Mathematics" (Oct. 1911, page 662 and others). Care should be taken to select problems which are real applications of geometry and which involve only terms familiar to the student.

2. Algebraic Methods. The use of algebra in geometry (a) correlates Algebra and Geometry, (b) gives practice in translating symbols into English, (c) leads to simpler notation, and (d) leads to the notion of functionality.

Illustrations of the algebraic method:—(a) Given in the right triangle ABC, c the hypotenuse, a and b the two legs; x projection of b on c, y the projection of a on c; to prove $c=a+d$. (Wentworth 371, p. 162)

(b) Given a the hypotenuse and b the sum of the two legs; to construct the right triangle.

Solution: $x+y=b$, $x^2+y^2=a^2$. Solving $x=\frac{1}{2}(b+\sqrt{2a^2-b^2})$ $y=\frac{1}{2}(b-\sqrt{2a^2-b^2})$, which values may be constructed with ruler and compass. (Sanders p. 211)

(c) Given line $AB=4r$ and C its middle point; on AB, AC, and CB semicircles are constructed. To draw a circle touching the three circles.

Solution: Let $x=$radius of required circle; then $(x+r)^2=r^2+(2r-x)^2$, and solving, $x=\frac{2}{3}r$. (Young p. 179.)

3. Locus problems. Locus problems deserve a place in Geometry because

(a) they introduce motion into our geometric notions, which would otherwise be entirely static,

(b) they are necessary in the solution of many construction problems,

(c) they develop the important notion of functionality.

In all locus proofs the two defining properties of a locus of a point should be emphasized, namely, (1) all points lying on the locus must satisfy the given conditions, and (2) all points which satisfy the given conditions must lie on the locus.

Illustrations of locus problems: — (a) Find the locus of all points at a constant distance from a fixed line.

(b) Find the locus of a point equidistant from two fixed points.

(c) What is the locus of the centers of circles tangent to a line at a given point?

In the study of loci advantage should be taken of the opportunities to introduce space notions. Thus, the locus of a point always a fixed distance from a fixed point in space is a sphere; of a point a fixed distance from line, is a cylindrical surface; etc. In general it is desirable throughout the course in Plane Geometry to call attention to the corresponding space forms of Solid Geometry.

F. Limits and Incommensurables.

The limit notion is needed to define such things as "length of a circle" (the limit of the perimeter of an inscribed, or circumscribed, polygon as the number of sides become infinite), "area of a circle", "surface of a sphere", etc., and therefore should be included in Elementary Geometry. A correct, though not most precise definition of a limit should be given and great care should be taken to avoid the commonly used but incorrect words "never reach." The following definition is recommended: "The limit of a variable is a constant such that as the variable approaches this constant their numerical difference becomes and remains less than any previously assigned positive number, however small."

The "Fundamental Theorems of Limits" as ordinarily stated, should be omitted as trivial. The following theorem should be introduced and used to show the existence of limits in Elementary Geometry: "If a variable always increases (decreases) and is always less than (greater than) some finite constant then it has a limit." Make this theorem seem true by illustrations, attempt no proof for it. Proofs of incommensurable cases should be omitted or postponed but some notion of the meaning of "incommensurable" should be developed.

G. Omissions.

List of omissions recommended: 1. Square of side of triangle opposite acute angle, etc.

2. Square of side of triangle opposite obtuse angle, etc.

3. Division into mean and extreme ratio.

4. Inscribed decagon.

5. Calculation of π by perimeter of inscribed and circumscribed polygon. Verify the value of π by some simpler method.

6. Proofs of theorems on limits.

7. Proofs of incommensurable cases, but not the incommensurable idea.

8. Maxima and minima.

9. Sum of two sides equal to twice the square of half the third increased, etc.

10. Difference of square of two sides, etc.

11. Square of bisector of angle equal to product of two sides, etc.

12. In any triangle the product of two sides equal to diameter of circumscribed circle multiplied, etc.

H. Emphasis.

The following topics should receive special emphasis:—

1. Congruence of triangles.
2. Similar triangles.
3. Pythagorean theorem.
4. Properties of circles.
5. Mensuration theorems.

I. Outline for Plane Geometry.

In the following outline certain important theorems (those starred) have been taken as nuclei about which are grouped related theorems. In this way important theorems are singled out for special emphasis and the content of the course is suggested.

I Congruent Triangles. *1. Triangles are equal if two sides and included angle, two angles and included side, or three sides, in one have equals in the other.

2. Propositions on right triangles.
3. Propositions on isosceles triangles.
4. Circumscribed and inscribed circle of triangle.

II Parallels and Parallelograms. *1. If two parallels are crossed by a third line the alternate interior, the alternate exterior, and the exterior interior angles are equal.

2. Angles having parallel sides are equal or supplementary.
3. Lines perpendicular to the same line are parallel.
4. Propositions on parallelograms.
5. If parallels intercept equals on one transversal they intercept equals on every transversal.
6. Sum of angles of a triangle.
7. Sum of interior angles of a polygon.

III Circles. *1. In the same circle or equal circles, equal chords are equidistant from the center, and converse.

*2. Central angle is equal to its intercepted arc.

*3. Equal chords subtend equal arcs, and converse.

4. Measurement of angle when the vertex is
   at the center of circle,
   between the center and the circle,
   on the circle,
   outside the circle,

5. Tangents from the same point are equal.

6. If two circles intersect, the line of centers is perpendicular bisector of common chord.

IV Similar Triangles. 1. If a line is parallel to one side of a triangle, it divides the other two sides proportionally, and converse.

*2. Triangles are similar when
   they are equiangular,
   two sides are proportional and included angles are equal,
   three sides are proportional.

3. Product formulas.
4. Similar right triangles.
5. Pythagorean theorem.
6. Trigonometric ratios.
7. Similar polygons may be divided into corresponding pairs of similar triangles, and converse.
8. Perimeters of similar polygons are proportional.

V Regular Polygons. *1. Regular polygons of the same number of sides are similar.
2. Length of circles are proportional to their radii.

$C = \pi r$

Some simple method of verifying value of π
3. Circles may be circumscribed about or inscribed in any regular polygon.
4. Side of hexagon is radius of circumscribed circle.
5. Inscribed equilateral polygon is regular.

VI Areas. *1. Area of rectangle is product of base by altitude.
2. Of parallelogram.
3. Of triangle.
4. Of trapezoid.
5. Of similar triangles.
6. Of similar polygons.
7. Of regular polygon is ½ perimeter by apothem.
8. Of circle.

OUTLINE FOR SOLID GEOMETRY.

Throughout the course in Solid Geometry efforts should be made to relate the work to Plane Geometry wherever possible. Special emphasis should be placed upon the real grasp of space notions and theorems; pictures, stereoscopic views, and models may be used to assist in grasping space relations but too great a use of such aids may work against the visualizing habit which is one of the chief values of Solid Geometry. Solid Geometry offers excellent opportunities for algebraic symbols and methods; it is recommended that mensuration rules be written in algebraic form but read in the translated English form. Logarithms may be used in computation problems if the second course in Algebra precedes Solid Geometry.

Additional Assumptions: 1. Two intersecting lines, two parallel lines, a straight line and a point outside that line, or three points not in a straight line, determine a plane.
*2. The intersection of two planes is a straight line.
*3. The projection of an oblique line on a plane is a straight line.
*4. Every plane section of a cone through its vertex is a triangle.
*5. Every plane section of a cylinder throughout an element is a parallelogram.
6. The shortest distance on a sphere between two points is the minor arc of the great circle joining them.

I Theorems closely related to Plane Geometry.

1. If two parallel planes are cut by a third plane the intersections are parallel.

2. If a line is parallel to a plane, then the intersection of that plane with any plane through the line is parallel to the line.

3. Equal oblique lines from a point in a perpendicular to a plane cut off equal distances, and converse.

4. Angles having sides parallel in same order are equal.

5. The plane bisecting a line at right angles is the locus of points equidistant from the ends of the line.

6. If two lines are cut by three parallel planes corresponding segments are proportional.

7. The angle a line makes with its projection on a plane is the least angle it makes with any line in the plane.

8. Two planes perpendicular to the same plane are parallel.

II Lines and Planes.

*1. A line perpendicular to two lines at their intersection is perpendicular to their plane.

2. Every line perpendicular to a line at a point lies in a plane perpendicular to the line at that point.

3. Through a point only one plane can be drawn perpendicular to a line.

4. If a line is perpendicular to a plane every plane through the line is perpendicular to the first plane.

5. If two planes are perpendicular, any line in one, perpendicular to their intersection, is perpendicular to the other plane.

6. If two intersecting planes are each perpendicular to a third their intersection is perpendicular to that third plane.

7. The locus of a point equidistant from sides of a dihedral is the bisecting plane of the dihedral.

III Spheres.

1. Every plane section of a sphere is a circle.

2. A plane tangent to a sphere is perpendicular to the radius at point of tangency.

3. The distances of a circle on a sphere from its poles are equal.

4. If a point on a sphere is at a quadrant's distance from the other points not at the extremities of a diameter, then it is the pole of the great circle through the two points.

5. A spherical angle is measured by the arc it intercepts on a great circle having its pole at the vertex of the angle.

IV Polyhedral angles and spherical triangles.

1. The sum of two face-angles of a trihedral is greater than the third.

2. The sum of the face-angles of a polyhedral is less than 4 right angles.

3. Two trihedral angles are equal or symmetric when two dihedrals and included face-angles, two face-angles and included dihedral, or three face-angles, in one have equals in the other.

4. The sum of two sides of a spherical triangle is greater than the third.
5. The perimeter of any polygon is less than 360°.
*6. Two spherical triangles are equal or symmetric when they have

A=A′	B=B′	c=c′
a=a′	b=b′	C=C′
a=a′	b=b′	c=c′
A=A′	B=B′	c=c′

7. If one spherical triangle is the polar of a second then the second is also the polar of the first.
*8. In two polar triangles any side of one is the supplement of the opposite side of the other.
9. The sum of the angles of a spherical triangle is more than two and less than six right angles.[1]

V Mensuration.

1. Lateral areas of prism, cylinder, regular pyramid, cone, and frustrum.
2. Area traced by line revolving about an axis in its plane.
3. Spherical areas; zone, sphere, lune, and spherical triangle.
4. Volumes

(a) Rectangular parallelopiped; by counting cubes formed by passing planes.

(b) Right prism, and cylinder as limit of inscribed prism as number of sides of base become infinite.

(c) Cavarlieri's Theorom: "Two solids having bases equal in area and equal altitudes are equal in volume if every two plane sections at same distance from base are equal in area." (Beman and Smith Geometry, p. 298) Illustrate without proof.

(d) Oblique prism and cylinder, by proving equal in volume to right prism and cylinder using (c).

(e) Pyramids and cones having same altitudes and bases equal in area are equal in volume; use (c).

(f) Volume of triangular pyramid.

(g) Any pyramid or cone, as sum, or limit of sum, of triangular pyramids.

(h) Frustrum as difference in volumes of two pyramids or cones.

(i) Sphere as equal in volume to certain cylinder having two cones removed from its volume, using (c).

(j) Spherical segments using (c).

5. Sensible use of approximations in measurements and computations.

18. GERMAN.

It is recommended that pupils be trained to understand spoken German and to reproduce freely in writing and orally what has been read. Whatever method of teaching is used, however, a thorough knowledge of grammar is expected. No attempt is made in what follows to give more than a general outline for the work of successive years, but the German department welcomes inquiries from teachers who wish further suggestions in the planning of courses.

First Year's Work.—At the end of the year pupils should be able to read intelligently and with accurate pronunciation simple German prose, to translate it into idiomatic English, and to answer in German easy questions on the passage read. A few short poems may well be memorized. Elementary grammar should be mastered up to the subjunctive as arranged in most books for beginners. Easy prose composition rather than the writing of forms will be the test of this grammatical work in entrance examinations given by the University.

Second Year's Work.—Only modern writers should be read, preference being given to material which has a distinctly German atmosphere and which lends itself readily to conversational treatment in the class room. The regular recitations should afford constant oral and written drill on the elementary grammar of the previous year. In addition, the beginner's book should be completed, but more importance is attached to accuracy and facility in simple modes of expression than to a theoretical knowledge of advanced syntax.

Third year's work.—Most of the time should be devoted to good modern prose. There should be some work in advanced prose composition—based on German models—and the daily recitations should continue to afford abundant oral practise. Pupils ought by this time to understand spoken German fairly well.

Fourth Year's Work.—At the end of this year a pupil should be able to read at sight any prose or verse of moderate difficulty. He should also be able to express himself orally or in writing with considerable readiness and a high degree of accuracy. It is recommended that work in composition take the form of free reproduction of portions of the texts studied rather than translation of English selections. The reading should be divided about equally between modern and classical authors.

The following report on standardization of the teaching of German is inserted from the Proceedings of the High School Conference for 1911:

I. Beginners' Books (Grammars) and Composition Books (Reported by Professor N. C. Brooks, University).

1. Composition Books.

An investigation as to usage in the state reveals the following facts. Only two regular composition books are used at all largely in the state. These are Bernhardt, used in the second year, and not found satisfactory as a rule; and Pope, used generally in the third year to which it is best adapted, and where it is found generally satisfactory.

While many teachers base the composition work upon reading texts, yet it is generally conceded that a regular composition text is better.

2. German Beginners' Books. (Reported by Miss Esther Massey).

Statistics submitted showed a wide range of preferences in texts. Among those leading are: Bacon's German Grammar, Spanhoofd's Lehrbuch der Deutschen Sprache, Vos' Essentials of German, Collar's First German Book, Becker-Rhoades' Elements of German and Joynes-Meissner (for beginners).

The expressed opinion of teachers reveal that the first three are most favorably received, and in the order named.

The general lack of unanimity makes standardization difficult. The committee expresses a hope that the German teachers of the state may ultimately agree

upon certain general principles about aims and methods that will lead to a reasonable degree of uniformity in all matters essential, and thus permit of some standardization of the work in beginning German and in Composition.

The direct method of presentation was strongly recommended.

II. German Readers.

Statistics show a large use of the reader in the first year and in the first part of the second. Statistics show Bacon's Im Vaterland to be most in favor. Other books used are Glueck Auf, Maerchen und Erzaehlungen, Herein, Daheim, Altes und Neues, Bilderbuch Ohne Bilder, Traeumereien, Wilcomen in Deutschland, Volkmann's Kleina Gaschichten, Caruth's German Reader, Muller's Neue Maedchen.

Not too much haste in introducing the reader is the advice of the committee.

III. The Tests Read. (Reported by O. P. Klopsch).

(1) To a careful student of the statistics sent to this committee during the past two years by the teachers of German in the high schools of Illinois, it is very evident that there is a strong tendency towards a considerable diminution of the kind of reading mostly in use in the high schools of our state in former years. This reading is rapidly being displaced by a comparatively new kind of material, and of this latter a much greater quantity is required to be mastered than the quantity of the displaced old material. Notwithstanding the fact that the courses were formerly shorter and the total amount of reading less, the number of great classics read was larger than nowadays and the critical study of them much more minute.

But evolution took place. On the one hand the student was better prepared for the reading of the classics by giving him a larger vocabulary and a better acquaintance with the German language and thought through the reading of an increasingly large number of the shorter and easier novels and Novellen of the more modern authors; while on the other hand the number of classics was reduced and only the easier and to the pupil more interesting ones were selected.

* * * * * * *

(2) If we turn to our statistics for the past two years and see what the most common courses of reading actually are—not what the teachers desire them to be—we find that, during the first year of the course, but a comparatively small number of schools read anything but the readers, excepting, of course, the reading selections found in the grammars.

During the second year some continue these readers the first semester, but the most schools begin the second year with some easy Novelle. The text most generally used is "Immensee," two-fifths of all the schools reporting two years ago used it the second year, and this year's reports show "Immensee" in three-fifths of the schools during the second year. In two year courses "Tell" is almost as much used, because many teachers feel that pupils should not leave school without at least a glimpse of one of the great classics. Next in popularity is "Hoeher als die Kirche." It is read in about one-half as many schools as "Immensee." A rather close race for third place is run by "Germelshausen," "L'Arrabbiata" and "Der Schwiegersohn." Most commonly three texts like those mentioned in this paragraph are read during the second year, in addition to the grammar work, the composition exercises and the drill in conversation. "Immensee" or "Ger-

melshausen'' are generally read during the first quarter, ''Hoeher als die Kirche'' or ''L'Arrabbiata'' during the second, and ''Der Schwiegersohn'' or ''Tell'' during the third.

In the third year ''Tell'' is unquestionably the favorite. It is usually read the first quarter. Some schools read ''Minna von Barnhelm'' instead. The friends of ''Tell'' for third year reading out-number those of any other classic three to one. Next in popularity is ''Hermann und Dorothea,'' generally found in the last quarter. And some Novelle or some novel is studied during the second quarter. There is not enough unanimity among teachers with regard to this for us to mention any one text as being practically prominent. Some schools read a third classic like ''Die Jungfrau von Orleans'' or possibly ''Marie Stuart'' instead of the novel or Novelle. For this third year of the course, as for the second, it is considered sufficient to read three texts during the year, if prose composition and German conversation are to be emphasized, as is mostly done.

Our statistics include comparatively few schools with four-year courses, so no attempt will be made to report on them.

(3) The present-day general tendencies, if not carried to extremes, should be productive of good results. The readers with the ''Realien'' do furnish a good basis from which to proceed to a study of the literary master-pieces. Some of the available readers are, however, too difficult for first year work. The mistake is commonly made of trying to accomplish too much in too short a time. We advance too rapidly in degree of difficulty in our readers and in our other texts. However desirable it may seem that pupils read some good easy Novelle at the end of the first year, it will be found practicable only under exceptionally favorable conditions. This is likewise true of the reading of a great classic, like ''Wilhelm Tell,'' during the second year. What a fine thing it would be, if pupils in two-year courses could come under the influence of ''Tell!'' But the majority of the teachers reporting, as well as the committee, feel that only in very exceptional cases are classes ready to take up ''Tell'' the second year.

The gap between ''Immensee'' and ''Tell'' is generally conceded to be a great one and there is some trouble in bridging it over. The objection to a use of ''L'Arrabbiata'' and ''Der Neffe als Onkel'' for this purpose, made by a constantly growing number of teachers, because of the foreign setting of these works, seems to be well made. This leaves ''Hoeher als die Kirche'' and ''Der Schwiegersohn'' as the favorites for the intermediate step. Both of these are fairly good, although ''Hoeher als die Kirche'' has a somewhat remote historical background for beginners, and a somewhat sickly sentimentality, and ''Der Schwiegersohn'' is too difficult for the first part of the second year, where it is put, if ''Tell'' is read in a two-year course.

In a three-year course matters are somewhat improved by reading ''Tell'' or ''Minna von Barnhem'' during the first quarter of the third year. This enables the teacher to put ''Der Schwiegersohn'' at the end of the second year, and leaves two quarters, one for ''Immensee'' or for ''Hoeher als die Kirche''—if it must be read—and the other for a continuation of the study of some book devoted especially to the ''Realien.''

Still better is the postponement of ''Tell'' to the second quarter of the third year, and the substitution of a more difficult Novelle for it in the first quar-

ter. The year may then be completed with a study of "Hermann und Dorothea." The latter is rather difficult for third year work, but ought to be given in a three-years' course to get the pupils somewhat acquainted with Goethe. If the novel to be read in the third year, like all the other reading, also is based on real German life, we shall have a course which ought to be distinctively German, German not only in language but also in contents. Such a course will materially increase the pupil's sympathy with German life, without adding any more pages to this already large enough amount of reading.

As a result of our study of the high school conditions in Illinois we suggest the following courses in reading to meet a common desire for standardization.

First Year of Course.

Readers dealing with the "Realien," second half of year.

Second Year of Course.

1. Readers (Completed) (German legends and history in easy prose and poetry) or 1. " "	2. "Der Weg zum Glueck." ("Der Ruegenfahrer" and "Tot oder Lebendig?") 2. "Immensee" 2. A good edition of "Der Neid."	3. "Aus Herz und Welt." ("Hundret Schimmel!" and "Alle Fuenf!") 3. "Der Schwiegersohn" 3. "Der Geissbub von Engelberg."

Third Year of Course.

1. "Karl Heinrich" or 1. "Fritz auf Ferien" or 1. "Die Journalisten."	2. "Wilhelm Tell." 2. "Minna von Barnhelm" 2. "Ekkehard"	3. "Der Schuss von der Kanzel." 3. "Herman und Dorothea." 3. "Goetz von Berlichingen" (As edited for high schools)

(Some of the above, like "Karl Heinrich" and "Ekkehard," can be read in class only in the abridged editions, especially prepared for American co-educational high schools.)

IV. Translation from German into English. (Reported by Professor C. L. Esbjorn, Augustana College.)

Question No. 4 in the question blank sent out by the Committee reads as follows:—"*To what extent do you use, or favor using, translation from German into English?*" The answers received indicate a great diversity of opinion as well as practice. Though a number of the answers fail to give quantitatively exact information, it seems on the whole a fair inference from the statements made, that approximately one-half of the teachers insist on the translation of from fifty to one hundred per cent of the reading matter of their respective courses.

On the other hand, the amount of translation in the remaining one-half of the schools appears to be small.

Question No. 5 in the questionaire was as follows: "*What are your substitutes for translation?*"

The leading answers may be grouped under three heads:—

First: Questions and answers on the lesson assigned, also reported as "conversation." This method takes different forms, such as: questions and answers in German; questions in German with answers in either German or English; oral or written discussion of grammatical constructions and principles; assigning the preparation of original questions to pupils, etc. One-half, or more, of the teachers make use of some form of questions and answers.

Second: Reproduction, "freie Reproduktion," or synopsis in German of the substance of the lesson. The number reporting this substitute for translation is almost one-half of the entire number.

Third: Reading the assignment aloud in class.

Those who employ reading by the class depend mainly on the expression with which the pupil reads, in deciding the question of his comprehension of the text.

Besides these three leading methods of testing a student's preparation of a reading lesson, the following are reported: Written exercises; written reviews; paraphrasing in German; German synonyms; definition of words in German; collecting idioms; dictation; "treating the language like the English;" retranslation of sentences of the teacher's invention based on the vocabulary of the text; "special topics, worked through a text, noting page and time of its appearance;" and a few others. A large number of teachers reporting using two, three or four of these "substitutes for translation."

As a great majority of the teachers who have reported are already employing translation into English to a greater or less extent, little need be said as to the advantages of this exercise. It cannot be successfully denied that translation furnishes an accurate method of ascertaining a pupil's comprehension of a passage in a foreign language. No paraphrase, no answers to questions, no elocution in the reading of a passage can give the immediate and incontrovertible evidence of its thorough comprehension furnished by a faithful translation. When the object, therefore, is simply to ascertain whether the foreign text is understood, no method is superior to translation. And yet it cannot be doubted that, with any class making good progress, the time soon comes when translation should cease, and other methods of hearing the reading lesson take its place. The first reason for this is that translation soon becomes to a great extent *superfluous*. If the reading material is properly graded, the class will ere long have mastered all the most common words and constructions, and the proportion of new words and phrases will in consequence be a constantly diminishing quantity. Translation thus tends to become more and more a useless repetition of what has been recited many times before. The second reason is that ability to translate into the vernacular is self-evidently not the ultimate object of the study of any foreign language. What our students must aim at is the ability to read German "as a German reads it." The teacher must therefore, when the proper time arrives, use every effort to wean the pupil from "the translation habit," and to induce him to adopt the "direct method."

This process must begin in the class room, and the writer is of the opinion that the end sought can be most surely and expeditiously attained by the simple

plan of the teacher's reading the daily lesson aloud to the class and asking questions on it as he goes along. In this way the pupil gradually learns to follow the development of the thought in the foreign order and to catch the meaning directly from the foreign words. Translation being no longer required in class, the student naturally drops it when preparing his lessons at home, and before he is aware of the transition, he is a reader, not a translator, of the foreign language. As a means of testing a student's preparation at every point, this method compares favorably with translation, since the teacher can stop at any moment, even in the middle of a sentence, to ask for the meaning of a word or phrase. A special advantage of the reading plan over translation is that it trains the ear as well as the eye of the pupil, since it is to be presumed that no one will attempt to instruct a high school class in German who is unable to read German with correct pronunciation and good expression. A lesson thus read over to the class, after preparation by the student, will often gain immensely in vividness and power to impress itself on the mind of the young learner. Another consideration in favor of this plan is that it is usually more rapid than translation. The gain in time may be estimated probably at fifty percent. The method may be varied by having the pupil do the reading; the special advantages of which exercise are sufficiently obvious.

But, excellent as the reading method is when properly used, it, too, eventually outgrows its usefulness. If the student is to read a sufficient amount to enable him to grasp the meaning of ordinary German at sight, he will sooner or later have to prepare home lessons too long, and with difficulties occurring too rarely, to make even the reading of the assignment in class profitable or practicable. This is the time for free reproduction, for synopses, for questions and answers, or for these methods combined in various proportions.

To teachers who feel it to be their main object to impart to their pupils a reading knowledge of German, the writer would, therefore, recommend: 1. Translation; 2. Reading aloud to class, followed by, or varied with, the reading *by* the class; 3. Free reproduction, questions and answers, synopses, or some similar method or methods. The exact point at which the transition should be made from the first stage to the second, and from the second to the third, must be left to each teacher's own judgment.

When learning to use the German language conversationally is considered the main object, or at least a leading object, the active use of the language on the part of a student must, as a matter of course, be introduced at the earliest possible moment and be continued in season and out of season. Then free reproduction, questions and answers, and similar methods from the beginning offer superior advantages.

19. GREEK.

First Year's Work.—The exercises in any of the beginning books, and one book of the Anabasis or its equivalent.

Second Year's Work.—Two additional books of the Anabasis and three of Homer, or their equivalents, together with an amount of Greek prose composition equal to one exercise a week for one year.

Third Year's Work.—Three additional books of the Iliad, three of the Odyssey, and Books VI, VII, VIII of Herodotus, or an equivalent from other authors.

20. HISTORY.

One, two, or three units may be presented, to be chosen from the following list:

Ancient history to 800 A. D., one unit.
Medieval and modern history, one unit.
English history, one-half or one unit.
American history, one-half or one unit.

Examinations for entrance will be given in all these subjects. The examination for each unit is intended to cover one full year of high-school work.

21. LATIN.

First Year's Work.—Such knowledge of inflections and syntax as is given in any good preparatory Latin book, together with the ability to read simple fables and stories.

Second Year's Work.—Four books of Caesar's Gallic War, or its equivalent in Latin of equal difficulty; the ability to write simple Latin based on the text.

Third Year's Work.—Six orations of Cicero; the ability to write simple Latin based on the text; the simpler historical references and the fundamental facts of Latin syntax.

Fourth Year's Work.—Six books of Virgil's Aeneid, with history and mythology; the scansion of hexameter verse.

The reports of committees of the Classics Section of the High School Conference on First, Second, and Third Year Latin, as given in the Proceedings for 1911, 1913 and 1914 contain many helpful suggestions for high-school teachers of Latin.

22. MANUAL TRAINING.

The requirement for one unit is the equivalent of 360 forty-minute periods in manual training following the syllabus prepared by the manual-training section of the High School Conference.

Following is the conference recommendation approved as a basis for accrediting Manual Training:

Outline of a One-Year Course in Woodworking for High Schools

This course is intended to occupy 120 hours—ten 40-minute periods a week for 18 weeks, or five 40-minute periods a week for 36 weeks, and presupposes that pupils have taken a 60-hour course in the grammar school before entering.

GROUP	PROCESSES	PROBLEMS
I—Review of the fundamental tool processes taught in the grammar school. Saw, plane, chisel and laying out tools. *Grooved joints and halving.*	Measuring, squaring, gauging, sawing, boring, chiseling, rules for sharpening tools, planing cylinder, use of screws and nails, carving finishing.	Bench-hook Specimen of wood for museum Book-rack Nail-box Tool-box Towel-roller
II—More exact work in planing to make a *glue joint.*	Planing joints, gluing, clamping, surfacing, sandpapering.	Drawing board Tee-square
III—Construction by means of *mortise and tenon joint.*	Laying out duplicate parts, cutting mortise, testing mortise, sawing tenon, gluing and clamping, scraping, finishing.	Taboret Book shelves involving keyed construction Stool Seat
IV—Construction involving the *miter joint.*	Designing a frame for a given picture, planing parallel edges and sides in the construction of a miter-box, rabbeting, sawing the miter-box, laying out and cutting a brace.	Framing a picture Bracket
V—Construction involving the *dovetail joint.*	Laying out and cutting dovetails, planing corners, inlaying, finishing.	Tool-chest Treasure-box Box for drawing instruments Book slides
VI—Construction involving the *panel.*	Planing, fitting, gluing, clamping, putting on hinges, finishing.	Screen Cabinet Bookcase Desk
VII—*Wood turning* NOTE: — This group may be omitted or may be substituted for a part of V and VI.	Spindle turning cylinder, cone, convex curve, concave curve, compound curve; turning on face-plate, chuck turning, finishing and polishing in the lathe.	Practice exercise Spool, Box with cover Legs for a stool, Tray Indian clubs, Rosette, Tool handle, Mallet, Circular picture frame

The other half-year, given preferably as a parallel course, but acceptable as preceding the woodwork, is a course in mechanical drawing, outlined as follows by the Conference:

GROUP	PROBLEMS	RELATION TO OTHER SUBJECTS	RELATION TO INDUSTRY
I—Straight lines measurements, use of tee-square and triangles in drawing horizontal, vertical and inclined lines. Use of ruling pen. Conventional lines. Freehand working sketches.	Rectangular frame triangular frame, trysquare, Bracket Box Bench-hook	*Geometry*— Straight line determined by two points or one point and a direction. Division of right angle into halves and thirds.	*Drafting*— Practical methods of drawing straight lines and angles of 90°, 60°, 30°, 45°. *Woodworking.*

GROUP	PROBLEMS	RELATION TO OTHER SUBJECTS	RELATION TO INDUSTRY
II—Circles, use of compasses, use of center lines, cross hatching sections.	Ring Circular picture frame Flower pot Cylinder head Circular box	*Geometry*	*Woodturning*
III—Tangents, finding centers and points of tangency.	Torous, Gland, Crank, Face-plate, Bearing, Link	*Geometry*—A tangent to a circle is perpendicular to a radius at the point of tangency.	*Manufacture of Engines and Machinery.*
IV—Planes of projection — projecting to horizontal and vertical planes, revolution of planes construction geometric figures.	Rectangular prism Octagonal prism Hexagonal prism Pentagonal pyramid. Triangular pyramid.	*Geometry*— Construction of hexagon, octagon and pentagon. *Descriptive Geometry*—revolution of planes and points.	*Drafting* — Practical methods of constructing octagon and hexagon, having given a side or the diagonal or the diameter.
V—*Revolution of Solids* (a) two views of object with sides parallel to planes of projection. (b) ditto, object tipped to a given angle with the horizontal plane. (c) ditto, object tipped to giving angle with the vertical plane. (d) ditto, object tipped to giving angles with both planes.	Cube Cross Angle Block Square pyramid Rectangular prism Triangular prism	*Descriptive Geometry*—revolution of solids.	*Architectural and Engineering Drafting.*
VI—*Developments* (a) Prism (b) Cylinder (c) Pyramid (d) Cone	Prism cut by a plane. Cylinder cut by a plane. Pyramid cut by a plane. Funnel, pan.	*Analytic geometry* Construction of ellipse, plotting curves.	*Tinsmithing—Pattern drafting.*

GROUP	PROBLEMS	RELATION TO OTHER SUBJECTS	RELATION TO INDUSTRY
VII—Intersections (a) centers in the same plane (b) centers in different planes.	Cylinder cut by a prism. Two cylinders of different diameters intersecting. Sphere cut by a prism.	*Analytic geometry* Plotting curves.	*Cornice-making*— Patterns for intersectiong parts.
VIII—*Lettering* Emphasis on (a) placing (b) form (c) slant (d) spacing (e) stroke	Gothic alphabet and figures. Texts in freehand, hairline, gothic, stump writing.	*Design* — study of composition.	*Commercial designing. Drafting.*
IX—*Working Drawings* Furniture	Towel-roller table, stool, screen, cabinet	*Woodworking.*	*Furniture designing and manufacturing.*
X—*Working Drawings* Machine part	Wrench, pulley coupling, pillow block.	*Machine tool work.*	*Manufacture of Machinery.*
XI—*Building plan* Floor plans and elevations or perspectives	Summer cottage, railway station, small suburban house.	*Freehand drawing.*	*Architecture Building.*

Suggested Treatment of Prorlems in Bench Work

PROBLEM	RELATED DRAWING AND DESIGN	RELATION TO OTHER SCHOOL SUBJECTS	RELATION TO INDUSTRY
Bench-hook	Working drawing to be made, or working drawing given to work from.	*Botany.* — Study of pine tree, how trees grow, sap wood and heart wood.	*Lumbering.* — Logging, sawing, seasoning.
Specimen of wood for museum	Working drawing.	*Botany.*—Study of selected trees, characteristics of different woods, classification of woods.	*Manufacture of Nails.* —Process, sizes. *Forestry.*— Geographical distribution of varieties, trees studied, tree planting.
Book-rack	Design freehand the contour of end and base. Make design for ends. Make working drawing to scale and full size drawing of end. Study of color of finish.		*Furniture making.*— Selection of wood with reference to cost, ease in working, durability, finishing. *Manufacture of Sandpaper.* — How made, grades.

PROBLEM	RELATED DRAWING AND DESIGN	RELATION TO OTHER SCHOOL SUBJECTS	RELATION TO INDUSTRY
Towel-roller	Working drawing (Design may be made for back and ends.)	*Geometry.* — To inscribe an octagon in a square.	*Manufacture of Screws.*—How screws are made, kinds of screws, for wood, sizes.
Drawing-board	Working drawing.	*Botany.* — Study of annular rings in wood.	*Cabinet making.*—Selection and use of wood with reference to shrinkage and warping. *Manufacture of Glue.* —What glue comes from and how refined.
Tee Square	Working drawing.	*Botany.* — Porous woods, and close-grained woods—ash and maple, for example.	*Instrument Making.*—Selection of woods for smoothness and for holding of shape.
Stool	Freehand Sketch constructive design, followed by working drawing.	*Botany.* — Study of Medullary rays in wood.	*Millwork.* — Quarter sawing.

For the second unit in manual training to be used for entrance credit, selection may be allowed as follows:

1. Machine Drawing,—120 or 240 hrs.
2. Wood Turning and Pattern Making, including principles of molding, 120 hours.
3. Wood Turning and Furniture and Cabinet Making, 120 or 240 hours.
4. Forging, 120 hours.
5. Machine Shop Practice, 120 or 240 hours.

Any combination of the above groups may be made, provided at least 120 hours of work are offered from each group. (For complete outline of the above courses, see Conference Proceedings, 1910, pp. 49-58.)

23. MUSIC.

At the present time (June, 1915,) no high schools are accredited in Music, and credit is therefore given only by examination at the university. As soon as possible, however, schools offering acceptable work in music will be accredited to the extent of one or two units.

Following are the Definitions of Units for Accrediting:

Courses in Harmony, History of Music and Musical Appreciation will be accredited on the same basis as other High School courses, namely: Five hours of recitation per week and five hours of preparation per week for 36 weeks will receive one unit of credits. Five hours of recitation per week without preparation will receive one-half unit. Written work will be required in all courses, but preeminently in Harmony.

I. HARMONY, FIRST YEAR.

Elements of musical notation; Construction of Major and Minor scales; Keys; Signatures; Intervals; general and specific; Key relationships; Consonances and Dissonances; Triads, Primary and Secondary; Inversions of Triads; Chord Progressions; Simple Melodies harmonized with Tonic Dominant and Sub-dominant harmonies.

SECOND YEAR.

Review of Triads; Seventh chords, Primary and Secondary; Harmonization of simple Melodies with Triads and Seventh Chords; Harmonic Analysis; Original Work.

II. History of Music: A Text-book course, with recitations and written work, touching the beginnings of music, and including a fairly comprehensive study of the development of music since A. D. 1600 and acquaintance with the lives and productions of the greatest composers and performers. One year.

III. Music Appreciation based upon the standard choruses and instrumental selections from the works of the great composers of each epoch, with instructions in Elementary Theory, Sight-Singing and Ear-Training. One year.

IV. A composite course may be offered including Harmony, History of Music and Musical Appreciation, any two of these subjects, and subject to the same regulations, with the added specification that in such a course at least one recitation per week in Harmony, with written preparation, shall be included. Two years.

V. Regulation regarding Teachers.

No High School Music will be accredited for entrance to the University where the Teacher of Harmony or History of Music to be offered for accrediting has not had at least a year of study in the subject to be taught in some professional training school, unless he has received a diploma or degree from some recognized institution for the training of musicians or music teachers.

24. PHYSICS.

One year's high-school work covering the elements of physical science as presented in the best of the current high-school text-books of physics. Laboratory practise in elementary quantitative experiments should accompany the text-book work. The candidate's laboratory note-book will be considered as part of the examination.

Following is a syllabus for a one year course in Physics as adopted by the Physical Science Section of the High School Conference, November, 1912:

Syllabus for Physics.

I. Introduction.

A. Metric system.

Linear measure, units: meter, centimeter.

Square measure: centimeter only.

Cubic measure: cubic centimeter, liter.

Mass: kilogram, gram and decimal parts.

B. States of matter. Defined and explained. Kinetic theory of matter.
C. Properties of matter, illustrated and explained. This should include a study of the evidences of molecular motions and molecular forces in solids, liquids and gases.
D. The moisture in the air. Including a study of conditions necessary to the formation of dew, fog, rain, snow, etc.
E. Evaporation. The conditions affecting it and the results produced by it.

II. Force and Motion.
A. Forces: kinds, their measurements and graphic presentation.
B. Motion, forms. Newton's laws of motion: inertia, momentum, and reaction.
C. Resolution of forces. Uses, applications.
D. Moment of force, defined, explained. Parallel forces.
E. Gravitation and Gravity.
1. General law.
2. Causes of variation in weight.
3. Weight is proportional to mass.
4. Center of gravity, how determined.
5. States of equilbrium. Stability.
F. Falling bodies.
G. Curvilinear motion, centrifugal force.

III. Work and Energy.
A. Work, definition, measurement.
B. Energy, five forms, two kinds, formulas, measurement.
C. Power, units, relation, problems.
D. Machines, use terms "effort" and "resistance." Mechanical advantage.
E. Lever, three classes, applications.
F. Wheel and Axle and Pulley, applications.
G. Inclined plane. (Effort parallel to incline.)
H. Efficiency and Friction. Measurement, uses.
I. Power tests of motors and engines.

IV. Hydrostatics.
A. Gravity pressure: varying depth, area, density of liquids, direction, shape of vessel. Communicating vessels. Problems on rectangular areas only.
B. Pascal's law. Areas given, applications.
C. Laws of buoyancy.
1. Archimedes' principle.
2. Laws of flotation.
3. Problems.
D. Specific gravity and density.
1. Specific gravity of solids.
Bodies denser than water. Problems.

2. Specific gravity of liquids.
   a. Bottle method. Problems.

V. Pneumatics.

Gas pressure due to (1) gravity, (2) molecular motion.

A. Weight and pressure of the air.
   1. Evidences (qualitative).
   . Measurement. Use of barometer.

B. Relation of volume and pressure. Boyle's law.

C. Applications: Pumps,—air, lift, force, use of air dome; siphons, baloon.

VI. Heat.

A. Heat, definition, its sources and effects.

B. Temperature, measurement. Thermometers, their construction and limitations.

C. Expansion:
   a. of solids, (qualitative).
   b. of liquids, anomalous expansion of water.
   c. of gases, absolute zero. Law of Charles.

D. Modes of Transmitting Heat.
   1. Conduction } discussed
   2. Convection } and
   3. Radiation } illustrated.
   4. Applications in heating and ventilation.

E. Heat and Work.
   a. Mechanical equivalent.
   b. Explanation of the action of heat engines.

F. Measurement of heat. Calorie and B. T. U. Specific heat.

G. Change of state. Heat of fusion and vaporation.
Determination, effects, applications.

VII. Magnetism and Static Electricity.

A. Magnets: natural, artificial, permanent, temporary.

B. General properties of magnets.

C. Magnetic induction and the molecular theory of magnetism.

D. The earth's magnetism as shown by:
   1. Magnetic compass.
   2. Magnetic dip and declination.
   3. Magnetic induction of the earth.

E. Electrification by friction, kinds of electric charges.

F. Conduction and theories of electricity.

G. Electrostatic induction and electric fields.
Distribution of charges.

H. Electric condensers and capacity.

VIII. Current Electricity.

A. Electric circuits and conditions necessary for the production of electric currents.

B. The simple cell, action, polarization and local action.
C. Practical voltaic cells.
   1. Leclanche, wet and dry. } Construction, Action, Uses.
   2. Daniell cell. }
D. Magnetic effect of electric currents.
   1. Electromagnet, electric bell, telegraph.
   2. Relation between current and magnetic field.
   3. Use in current measuring instruments: voltmeter and ammeter.
E. Resistance and Ohm's law.
   1. Conditions affecting resistance.
   2. Effect of combining conductors in parallel series.
   3. Measurement.
      a. Volt-ammeter method.
      b. Wheatstone bridge method.
F. Chemical effect of an electric current.
   1. Electrolysis of water.
   2. Electroplating.
   3. The storage battery.
G. Electric power and its determination.
H. The heat effect of electric currents.
   1. Fuse wire.
   2. Electric heating and cooking.
   3. Arc and incandescent lamps.
I. Electro-magnetic induction.
   Laws { Production, Intensity, Direction } Illustrated by magnets and coil with bar magnet.
J. The dynamo—two-pole field, single rotating loop or coil, alternating and direct.
K. Simple electric motor, two poles. Efficiency of an electric motor.
L. The induction coil and transformer. Uses. Differences.
M. The telephone.
N. Wireless telegraphy.

IX. Sound.
A. Nature, source, speed, medium.
   Reflection of sound, echoes.
B. Waves and wave motion.
   Illustrated by water waves showing reflection, refraction and interference.
C. Characteristics of sound.
   1. Intensity—conditions affecting.
   2. Pitch, and rate of vibration.
   3. Quality and overtones.
D. Interference, beats, discord.

Resonance, sympathetic vibrations.

E. Musical scales, diatonic and tempered, uses.

F. Laws of vibrating strings and air columns.

G. Types of musical instruments.

Vibrating { plates or membranes, strings, air columns.

X. Light.

A. Rectilinear propagation of light, speed.
   1. Shadows.
   2. Pinhole camera.

B. Photometry.
   1. Intensity of light (source) and intensity of illumination distinguished.
   2. Law of inverse squares.

C. Reflection.
   1. Law of reflection.
   2. Regular, diffused.
   3. Plane mirrors, position and character of image.

D. Refraction.
   1. Definition and explanation.
   2. Refraction of parallel sided plates.
   3. Refraction by prisms and lenses.

E. The formation of images by lenses.
   1. Converging and diverging lenses.
   2. Position and character of images formed by converging lenses.

F. Optical instruments.
   1. Eye, camera.
   2. Microscope, simple, compound. Telescope.

G. Color and spectra.
   Dispersion, achromatic lenses. Uses of spectra.

H. Interference and polarization.
   The nature of light.
   Medium, length and character of waves.

Suggested List of Experiments in High School Physics.

Mechanics.

(Twelve of the starred experiments are recommended as a minimum.)

I. Preliminary.
   *1. Measurement of length. Compare English and metric measurements.
   2. Measurements of volume. (Teach use of calipers.)
   3. Vernier calipers.
   4. Micrometer calipers.
   *5. Study of graphs. (Use graph to show the relation between English and metric units.)

II. Mechanics of solids.
*6. Parallelogram of forces.
*a. Problem: Crane stresses or some other practical exercise involving balanced forces acting at angles with one another.
*7. Parallel forces.
*a. Problem: Center of gravity.
*8. The lever and the principle of movements.
*9. The inclined plane. (Efficiency of a machine.)
*10. The pulley. The wheel and axle. (Mechanical advantage.)
*11. Elasticity and Hooke's law by:
*a. Calibration of a spring or by use of Jolly balance.
*b. Bending rods.
c. Twisting rods.
12. Cohesion. The breaking strength of a wire.
13. Friction.
*14. Falling bodies.
*15 The pendulum.

III. Mechanics of Fluids.
*16. Density of water. (Use of beam balance.)
*17. Archimedes principle.
a. Bodies that sink in water.
b. Bodies that float in water.
*18. Specific gravity of solids denser than water.
a. By a spring or beam balance.
*19. Specific gravity of solids less dense than water.
a. By a beam or spring balance.
*20. Specific gravity of a liquid by:
a. Spring or balance beam.
b. Specific gravity bottle.
c. A constant weight hydrometer.
d. A U tube.
e. A Y tube.
*21. Measuring air pressure. Use of a barometer.
*22. Measurement of pressure:
*a. Of liquids at varying depths.
*b. Of gas or water pressure.
*23. Boyle's law.

Heat.

(Five of the starred experiments are recommended as a minimum.)
*1. Testing the fixed points of a mercury in glass thermometer.
*2. Relative conductivity of various solids.
*3. Coefficient of linear thermal expansion of a solid.
*4. Calorimetry. Mixing water at different temperatures and determining the thermal capacity of the calorimeter.
*5. Determination of specific heat by the method of mixtures.
*6. Determination of heat of fusion.

*7. Determination of heat of vaporization.
*8. Determination of dew point of the atmosphere.
9. a. Determination of the change of volume of a gas at constant pressure, with change of temperature.
b. Determination of the change of pressure of a gas at constant volume.
10. Fixing of melting and solidifying point.
*11. Vapor tension of alcohol.

Electricity and Magnetism.

(Ten of the starred experiments are recommended as a minimum.)

*1. Fundamental facts of magnets.
*2. To map the field of a magnet.
a. By blue print.
b. By a compass.
3. Magnetic induction and the earth's magnetism.
production of static electricity by friction. A study of conductors and insulators.
5. Electrostatic induction, condensers.
*6. Study of simple galvanic cells.
*7. Study of the magnetic field about wires carrying an electric current.
*8. Study of the electromagnet.
*9. Study of electric bell, telegraph, sounder or relay.
*10. Study of a galvanometer or ammeter, using same in electric circuits. Ohm's law.
11. Study of two fluid galvanic cells.
*12. Study of electrolysis.
13. Electromotive forces of various cells by:
a. Use of volt-ammeter.
b. Use of ammeter with a constant resistence.
*14. Arrangement of cells in connection with varying external resistance.
*15 Measurement of resistance of wires by:
a. Wheatstone bridge method.
b. Volt-ammeter method.
*16. A study of resistance connected in series and in parallel.
17. Effect of temperature upon resistance of wires.
*18. Electromagnetic induction.
*19. Study of dynamo or motor.

Sound.

(Three of the starred experiments are recommended as a minimum.)

*1. Study of wave motion by use of wave trough.
*2. Velocity of sound in air.
*3. Wave length of sound in air.
*4. Number of vibrations of a tuning fork.
*5. Interference of sound.
*6. Laws of vibrating strings or air columns.

Light.

(Six of the starred experiments are recommended as a minimum.)

1. Images formed by a pin-hole aperture.
*2. Photometry.
   a. Study of the effect of distance upon intensity.
   b. Comparison of intensities.
*3. Law of reflection, images in a plane mirror.
*4. Images in a concave mirror.
5. Images in a convex mirror.
*6. Study of refraction by plate, prism, lens.
*7. Index of refraction of glass or water.
*8. Determination of the principal focus of a convex lens and a study of real and virtual images formed by it.
*9. Study of two of the following:
   a. Refracting telescope.
   b. Compound microscope.
   c. Opera glass.
*10. Study of spectra.

Practical Applications.

The following list gives a few of the applications of the principles involved in the various experiments or cases in which they must be taken into consideration.

Mechanics.

Exp. No.

6. Wind and current pressure on sails and rudder of a ship, on planes of an aeroplane, on rudder of canal boat.
7. Bridge trusses. Single and double tree.
8. Shears, nut-cracker, crowbar, nail puller, balance, steel-yard, pump-handle, boat oar, bracket, safety-valve, human arm, pincers, wheel-barrow.
9. Screw, wedge, ladders, lifting jack, screw press, gang plank, vise, screw propeller, air fan, inclined railroads.
10. Block and tackle, geared cap-stem, windlass, derrick, water wheels and turbines.
11. Spring balance, spiral springs and wagon springs. Structural beams and trusses, shafting.
12. Suspension bridge, two lines.
13. Bearings, friction gears, belting, brakes, wheels on roadway.
14. Range of projectiles.
15. Clocks, determination of acceleration of gravity, metronome, work of bureau of standards.
17. Balloons, ships, life preservers, floating dock. Buoyancy of air.
20. Lactometers, Alcoholometers.
    Testing for adulteration of milk, oil, etc.
    Gravitational separation of liquids, cream separator.
21. Study of pumps, open manometer, siphon.
22. Construction of dams, siphon, standpipe, hydrostatic press.
23. Diving bell, caisson, closed manometer, compressed air, air brakes, bellows.

Sound.

1. Illustration of phenomena of wave motion.
   Stationary waves, reflection, refraction, interference.
2. Acoustics of buildings.
   Organ pipes (length of) echoes.
3. Comparison of pitches, measurement of time intervals.
5. Harmony.
6. Stringed instruments.

3, 4, 5. Theory of music.

Heat.

1. Calibration of thermometers. Bureau of standards,
2. Great variation in conducting power of substances.
3. End rollers on bridges. Dial thermometers. Spacing of railroad rails. Compensation pendulum, balance wheel. Metallic thermometers. Thermoregulators (thermostats).
8. Heating and ventilation. Convection currents in nature, trade winds, ocean currents.
6. Ice in refrigerator, cooling of buildings.
7. Steam heating. Steam engine. Ice making, cold storage.
8. Hydrometers, fogs, clouds, rain, snow.
9. Gas, thermometer.
10. Alloys, waxes.
8. Better understanding of heat engines.

Light.

8. Eclipses.
1. Action of camera.
2. Comparison of light intensities.
3. 4, 5. Optical instruments, reflectors for vehicle lamps, search lights, etc., sextant.
6. Displacement of objects through glass
   Position or direction of immersed objects.
   Reflection by right angled prism.
8, 9. Optical instruments, microscopes, telescopes, collimator, eyeglasses, projection lantern, photographic camera, stereoscopes.
10. Spectrometer and spectrum analysis.
8. Saccharimeter, polariscopes.

Electricity and Magnetism.

1, 2, 3. Ships compass, dipping needle, etc. Magnetic separation of metals. Magnetic charts, etc., of Bureau of Commerce and Labor.
4, 5. Electrometers, lighting rods, condensers, Roentgen rays, generators, etc., brush discharge from high potential lines, static charge produced by belts, grounding by combs.
9. Electromagnetic apparatus, sounders, relays.
10. Galvanometers, ammeters, voltmeter. Measurement of electric current, etc.
8, 9, 10. Meters.

16. Calculation of electric circuits, use of tables, transmission, lighting, traction system, etc.

17S. Safe carrying capacity

S. Electric lighting, electric heating. Heating irons. Use of tables.

13, 14. Terminal potential of current sources.

18, 19. Telephone, induction coil, induction motor, dynamo, motors, transformers, electric lighting and motive power.

25. PHYSICAL GEOGRAPHY.

The amount and character of the work required may be seen by referring to the texts of Gilbert and Brigham, or Davis; the recitations must be supplemented by at least an equal amount of time devoted to laboratory work. The laboratory exercises should follow one or more lines such as are indicated below. Each student should prepare a note-book showing what he has done.

(a) Studies in mathematical geography in which map and scale only are used. These should embrace such topics as length of a degree in longitude in various latitudes; length and breadth of continents, etc., in degrees and miles; relative latitudes of places; distances between cities, etc., in degrees and miles; difference in length of parallels and meridians; problems in time; location of time belts, etc.

(b) Studies of local topographic features which illustrate the various phases of stream work. Each study should include a drawing or topographic map of the object, and a full, clear description of the way in which it was formed.

(c) Studies of glacial deposits as shown in terminal and ground moraines, kames, eskers, etc.; distribution of dark and light colored soils; occurrences of lakes, ponds, gravel beds, clay banks, and waterbearing strips of sand and gravel.

(d) Studies of stream work as shown in the topographical sheets which may be obtained from the United States Geological Survey at a nominal cost.

(e) Studies of the form, size, direction and rate of movement of high and low barometer areas, and the relation of these to direction of wind, character of cloud, distribution of heat, and amount of moisture in the air, as shown in the daily weather maps. Later these studies should lead to the making of weather maps from the data furnished by the daily papers, and to local prediction of weather changes based on the student's own observation.

(f) Studies of the climate of various countries compared with our own, the necessary data being derived from such topographic, rainfall, wind, current, and temperature maps as are found in Sydow-Wagner's or Longman's atlases.

NOTE.—For a good Physiography syllabus for the state of Illinois see Conference Proceedings for 1913, pp. 174-197.

26. PHYSIOLOGY.

For one-half unit: The anatomy, histology, and physiology of the human body and the essentials of hygiene, taught with the aid of charts and models to the extent shown in Martin's Human Body (Briefer Course). For more than one-half unit, the course must include practical laboratory work.

27. SPANISH.

First Year's Work.—Elementary grammar, including thorough drill in the irregular verbs; careful training in pronunciation, and translation of simple Spanish when spoken; reading of about 100 pages of easy prose; simple composition and dictation.

Second Year's Work.—In addition to the foregoing, about 300 pages of modern prose; elementary syntax; dictation, composition, and translation of spoken Spanish continued.

28. TRIGONOMETRY.

The work should cover the field of plane trigonometry, as given in standard text-books, including the solution of right and oblique triangles. Special emphasis is placed upon the solution of practical problems, trigonometric identities, and trigonometric equations.

29. ZOOLOGY.

The instruction must include laboratory work equivalent to four periods a week for a half-year, besides the time required for text-book and recitation work. Note-books and drawings must be presented to show the character of work done and the types of animals studied. The drawings are to be made from the objects themselves, not copied from illustrations, and the notes are to be a record of the student's own observations of the animals examined. The amount of equipment and the character of the surroundings must, of course, determine the nature of the work done and the kind of animals studied; but in any case the student should have at least a fairly accurate knowledge of the external anatomy of each of eight or ten animals distributed among several larger divisions of the animal kingdom, and should know something of their life histories and of their more obvious adaptations to environment. It is recommended that special attention be given to such facts as can be gained from a careful study of the living animal. The names of the largest divisions of the animal kingdom, with their most important distinguishing characters, and with illustrative examples selected, when practicable, from familiar forms, ought also to be known.

The following suggestive syllabus for Zoology was presented at the 1912 Conference:

A. INTRODUCTION.

In making this second step toward the formulation of a syllabus for the teaching of biology in the high schools of Illinois, your committee desires to refer you to the following statement made in the introduction to our report last year:

"A course in high school biology should seek the following, among the possible things:

"1. The production and conservation of a vital interest in plants and animals.

"2. An appreciation of the human values of plants and animals.

"3. The encouragement of the attitude of raising and solving problems concerning plants and animals.

"4. Some ability to use the library, the field, and the laboratory in individual pursuit of these interests.

"5. The ability to sustain interest in these problems through considerable periods.

"6. A sense of the way in which organisms respond to the environing conditions.

"7. An elementary conception of development and of the evolutionary series of animals and plants.

"8. Some knowledge of living material; its organization in plants and animals; its properties and the relation of these to the activities of the organism.

"9. Some experience in classification of organisms—theoretical and practical.

"10. A conception of the place of man in the biological series, along with the conviction that this does not invalidate, but rather heightens, the meaning of all the higher human qualities.

"11. A sane, wholesome appreciation of the origin and meaning of the sex, and of its bearing on human life.

"The committee believes that it is not desirable, even if possible, to have uniform courses in biology in the different schools of the state. We believe, however, that all exercises in all schools should be handled in such a way as to secure the 'scientific habit,' which includes among other things—the habit of correct observation; of accurate expression of these observations both by means of notes and drawings; of discriminating between superficial and essential observations; of correct thinking; and of willingness to retest the final conclusions when new evidence appears."

In the report of last year we undertook merely to indicate some general types of exercises which, in our opinion, were essential to an elementary course in zoology and in botany. In accordance with our instructions to proceed further with this work, it becomes necessary for us to indicate more exactly the special exercises, under these general types which were approved by you, which might be expected to accomplish the aims upon which we are agreed. This report offers tentatively such a list of topics for the subject of zoology.

The committee realizes that this is an unsatisfactory stage in which to report our progress—in that it goes beyond the sure ground of the very general statements in the first report, and yet does not give sufficient detail to justify itself as a manual. Without elaborate description, impossible in the limits of such a report, many of these exercises may appear to teachers as indefinite and equivocal. Effort has been made, however, to add such suggestions as will enable the teacher at least to see workable territory in each of the exercises.

If the conference wishes to go any further in this matter, the next step is the preparation, or the selection, of a practical manual of zoology in which each of the topics is elaborated in a suggestive way, with citations to some of the zoologies in current use in high schools, in connection with which this detailed syllabus might be used. It is hoped that this may be accomplished by the time of the next meeting, in case you decide to take this further step. One such exercise (Exercise No. 1) is given in detail, to illustrate what is possible.

Concerning the list of exercises, offered in the present report, the committee wishes to make the following remarks:

1. It is thoroughly well understood that all the exercises listed here cannot be handled in a scholarly way in one term, or even two terms. It is equally true that some teachers and some schools will be better fitted to emphasize some of the

exercises, and others for equally good reasons will prefer to use others. It is not the purpose to secure perfectly uniform iron-clad courses of zoology in our schools.

2. Teachers should feel free, therefore, to bend such a list of subjects to their needs. It is suggestive rather than final. It is intended to give a standard which shall include the *chief things for which a secondary course in zoology should stand,* and a suggestion of some of the kinds of exercises that may be used to meet these ends.

3. In case a whole year is given to zoology, with approximately five periods weekly, some of which ought to be double periods, something like one day could be given, on the average, to each of these proposed exercises. But even under these circumstances it will be found that the exercises are not of equal interest, importance, or difficulty; some may be very much abbreviated, or even omitted, and others will require much more than a double period to work out even in a superficial way. Some of the exercises may readily be elaborated so as to give profitable work for several days. In other instances two or more exercises may be concluded at one period. No teacher must allow any text-book or syllabus to determine the rate of passage through the subject; the interest and interests of the pupils, his own conception of the objects to be reached in the particular course, the degree to which the exercise is accomplishing the proposed objects, and such considerations must control his progress and his emphasis.

4. In schools where only one-half year of five periods a week is given to zoology, the teacher and class should select such exercises as seem to them most worth while—provided *some* exercises from *each* of the general realms are selected. The pupil should be induced to work and think in each of these main fields in order to have the subject fairly opened up to him. The amount of emphasis upon each field can well be left to be determined year by year in various schools in accordance with the principles suggested above.

5. The following exercises lend themselves to expansion: 8, 9, 19-29, 34-55, and almost any of those in Series X-XIV. The following are readily subject to abbreviation and combination: 10-13, 58-72, 93-105. Certain groups of exercises may be shortened, and yet retain a large part of their suggestiveness by assigning different exercises to different pupils for careful investigation; the results of these studies to be reported to the class, and there discussed. This is peculiarly true of Series VIII, XI, XIV—and, if necessary, XII and XIII.

6. In respect to order, it will be apparent to the teacher that some of these groups of exercises, if they are to be used at all, naturally belong where they are placed; others may readily be shifted into adjustment with the text-book in use, or with other conditions confronting the teacher.

Series I and II should naturally come very early; the calendar study for each pupil should be selected as soon as the pupil gets sufficient glimpse of the field to enable him to put some personality into the selection; the study of the representative animal should come while the animals chosen are plentiful and active; the Economic Studies (Series VIII) should come whenever the conditions are best for the study of each of them, since their arrangement is in no sense chronological; the same is true of Series XI—the development of animals. Most of the other series can be shifted to meet the local needs. The studies in Series XIV might very appropriately be assigned, one by one, at opportune points, through the course, for the purpose of enlivening interest and thus motivating the course.

Finally, your committee, in the light of its conviction that rigidly uniform courses are unwise, and in recognition of the diversity of views among equally good teachers, would suggest, without any definite recommendation, the following as the possible future constructive tasks of this section in the interest of the teaching of high school biology in Illinois:

1. The selection, or the formation, of a practical manual of zoology on the basis of the present report.

2. The preparation or selection of a practical syllabus and manual of botany in the same general spirit.

3. The preparation of a practical manual of biology, in which botany, zoology, and human physiology are really unified and not merely welded.

B. A Suggested Outline of Exercises for Practical Work in Zoology.

I. *Introductory. Exercises for Appreciation.* (Exercises 1-4.)

Purpose: To secure, early in the course and in an informal way, such a view of the subject-matter of biology and its relations to life that the student may have a real appreciation that will beget responsiveness.

Ex. 1. The Attractiveness of Nature. An informal study from memory, and a discussion, of the elements that tend to make nature beautiful and attractive to man.

Exercise 1, illustrated in detail.

Method: An exercise like this, may properly take the form first, of a conference of the class indoors, followed by an informal excursion to the nearest particularly attractive point of natural interest. Stereopticon, or other pictures, may be used very profitably to supplement, or even replace the excursion if the latter is not possible. The spontaneous expression of the pupil should be encouraged. The "Scientific Method" may properly be held in abeyance in these first exercises.

Topics:

1. The Student's Memory of His Most Beautiful Natural View. What kinds of things helped make it beautiful? What part did the form of land play in it? What part, water? What, clouds and "atmosphere"? What part did living objects, plant, or animal add? Why do you think such things seem beautiful to humans? Do you think this quality of appreciation in us can be cultivated and strengthened? Do you think it would, on the whole, add to the pleasure and value of life to strengthen it? Is it quite wise on our part to wait until we find all these elements of beauty in *one place* and in *extremer degree,* before we allow ourselves the pleasure and inspiration that come from appreciating them? What is the first quality we should try to cultivate in ourselves in order to get this pleasure? What next?

2. The Special Contribution of Living Objects to Natures Attractiveness.

As you think of the beauty of the earth, what is added to it by plants? In what ways do animals add to it? Mention what seem to you now the chief beauties and interest of plants; of animals. Supplement with appreciative literature, and with pictures in which plants and animals are attractively represented.

* * * * * * * *

Ex. 2. The Attractive Natural Points, Locally. A visit, a report, and a dis-

cussion of the most beautiful natural conditions in reach of the class, which may make a concrete test of the general conclusions in Exercise 1 concerning the beauties of nature.

Ex. 3. The Pupils' Present Knowledge of Plants. A summing up of the knowledge of the class respecting plants, their characteristics, their value to animals and to men, their place in human industry and business.

Ex. 4. The Pupils' Present Knowledge of Animals. A similar inventory of their appreciation of animal values and relations.

II. *Introducing to the Library and the Field.* (Exercises 5-9.)

Purpose: To acquaint the student with the books he will use, to teach him how to use them, to enable him to go willingly and with intelligence to the "field" in search for real problems and real solutions.

Ex. 5. A Library Exercise. Examination of available books, the making of a selected, classified list of a limited number, together with some broad estimate of the characteristics of at least a few of them. Discussion in class.

Ex. 6. A Preliminary Survey of the Territory. Examination by each student of a selected territory, with notes, and a map showing its general character. Reports. A list of questions suggested to the student by the study.

Ex. 7. A Special Survey of a Limited Territory. A general study, and report on the study, of *all* the observed animal life of a small area selected by the student. A list of the pupil's questions arising out of the study.

Ex. 8. A Collecting Excursion. The collecting and keeping in good condition of all animals captured on a special excursion; with notes about all animals found. List of questions for further study.

Ex. 9. Rough Identification of Animals Collected. Use of pictures, descriptions, and simplest possible keys, etc., to locate in a general way, the animals collected. This exercise may be extended, with profit, over several periods.

III. *Introducing to the Laboratory and Microscope.* (Exercises 10-13.)

Purpose: To acquaint the student with the general nature of work in the laboratory; to introduce him to the most remarkable instrument which we have to aid us in such studies; to enable him to get a mastery of the elementary use of the low power of the microscope. This series should be reduced to one or two exercises unless each student, or pair of students, has access to an instrument.

Ex. 10. The Construction of the Microscope. To get the main facts about the microscope, to suggest the uses of the parts, to show how structure and function are related.

Ex. 11. Securing Illumination. Theoretical and practical.

Ex. 12. Securing Focus. Theoretical and practical.

Ex. 13. Discovering the Effects of the Microscope on the Appearance of Objects.

IV. *Calendar Studies.*

Purpose: To bring the student into contact with some aspect of animal life in its successive relations through the year and thus encourage a sustained interest in some worth-while topic; to introduce the student to the seasonal rhythm of life and its meaning.

Method: These topics, preferably a different one for each pupil, should be selected early in the season, and should represent if possible some real interest of the student. There should be:

(1) A clear statement of the topic of study.

(2) An outline of the various methods of observation used.

(3) A statement of the results of the observations.

(4) Interesting or important conclusions based on the observations.

(5) A report of any studies by other people on the same subject, as contained in the literature, and a comparison of such with the pupil's results.

Suggested Topics:

1. Any exercises on the life history of animals. (See Exercises 95-107.)

2. Some of the economic studies. (Exercises 34-54.)

3. Record of the behavior of any common species of wild animals through the varying conditions of the year.

4. The effect of the seasons on any of the great vital functions of animals—as reproduction, general activity, securing food, etc.

5. Actual observable animal inhabitants of a given area of favorable territory throughout the year. (Statistical and descriptive.)

6. An account of the changes of the bird or other wild life of the community during the year.

7. Certain questions of variation, heredity, natural selection, etc. (See also Exercises 119-142.)

8. In general, any topic which suggests changes in the animal life day by day owing to climatic or other environmental conditions.

Ex. 14. Selection of Calendar Studies. A careful discussion, and selection by each student, of some calendar topic. The elements to be considered in such selection. Discussion of the general method of attack.

V. *The Laboratory Method, and an Inductive Study of the Chief Differences between Inorganisms and Organisms, Plants and Animals.* (Exercises 15-18.)

Purpose: To use a few familiar objects to introduce the pupil to the scientific method and to get before him, free from new and puzzling knowledge, the steps that must be followed in order to reach right conclusions; to give him practice in taking these steps; and to enable him to get for himself a definition of inorganic and organic, plant and animal.

Ex. 15. Sand. Pebbles. Crystals. Observe, record, and compare the really *observable* characteristics of these.

Ex. 16. Shells. Characteristics. Distinctive features; compare with sand, pebbles, and crystals.

Ex. 17. Plants. Study as above. Limit record to student's actual observations.

Ex. 18. Animals. Study as above. General conclusions. What are, after all, the *observable* distinctions between these five classes of objects?

VI. *The Study of a Representative Animal.* (Exercises 19-29.)

Purpose: The purpose of this series of exercises is to guide the student in forming the habit and ideal of accurate observation and in making a clear and

exact record of observations; to cause him to study with some care and in some detail the relations of one type of animal to its natural environment; to allow him to discover the work which it is capable of doing, and its chief adjustments to its manner of living, and to appreciate the complexity of the organization of the animal whereby it is enabled to do the work necessary for satisfactory living. (It is assumed in the following exercises that the grasshopper will be the most generally suitable animal.)

Ex. 19. Representative Animal: Introductory. A discussion of all the important things that enter into the determination of what will be a suitable animal. Select in the light of this discussion.

Ex. 20. Haunts and Habits of Life. A general study, in the field, of the place of living, general and special; kind of food used; relation to one another, and the like. Follow by reports and discussions in class.

Ex. 21. Its Chief Activities. A study of its powers—just what it can do; as motions, locomotion of various types, etc. A close study and analysis of the differences between these modes of action; and of the purposes of them.

Ex. 22. The External Organs and Their Relation to the Kinds of Activity. A tabular display of the relation between the structures and their functions.

Ex. 23. Sensitiveness. An observational and experimental study of the evidences of sensitiveness, the special kinds of sensitiveness, the location of the sense organs, the nature of the reponses, etc.

Ex. 24. Sensitiveness (continued). Tabular display of senses, organs, stimuli, etc.

Ex. 25. The General Plan. The symmetry of the animal. What elements enter into symmetry?

Ex. 26. The General Plan (continued). Comparison of the axes. The meaning of dorsal and ventral, anterior and posterior, right and left; and the location of the various organs in relation to these regions, and the reasons therefor.

Ex. 27. General Plan: The Regions of the Body. A study of the form and function and relations of three regions,—head, thorax and abdomen.

Ex. 28. Special Organs of the Three Chief Regions. A tabular display of all the organs related to each of the regions; their form, position, and functions, with drawings of them.

Ex. 29. Review of Representative Animal. Questions to unify the results of the study, and to apply the proper descriptive names to the organs.

VII. *Comparative Work in the Phylum to which the Representative Animal Belongs.* (*Arthropoda.*) (Exercises 30-33.)

Purpose: To cause the student to compare other slightly known animals with the grasshopper, and thus further emphasize his picture of the latter; to enable him to realize that his knowledge of animals in general is not exact; to give him a better conception of the group of insects and of its principal orders.

Ex. 30. *Off-Hand Comparison of Some Familiar Animals with the Grasshopper.* Enumerate from memory the main points of likeness and unlikeness between ten or fifteen known animals and the representative animal.

Ex. 31. Identification of Insects. Each student should identify a few of the common insects by means of keys, figures, knowledge of their common names, etc. Location of a few less known forms in their proper Orders.

Ex. 32. Comparison of Insects. A tabular comparison of a representative insect from several of the Orders as to habitat, mouth parts, wings, form of body, metamorphosis, larval habits, etc. (Field and library.) Definition of chief insect Orders.

Ex. 33. Comparison of Orthoptera (Tabular). A table bringing together with some exactness and from any source of information open to the student, the points of likeness and unlikeness of grasshopper and other orthoptera—as the cricket, katydid, cockroach, walking-stick, etc.

Comparison of Orthoptera (Illustrative Table.)

Characteristics		Cricket	Katydid	Cockroach	Pupil's Selection	Grasshopper
Habitat and habits						
Coloration and protective devices.						
Body	Shape					
	Regions					
	Proportions					
	Segments					
Thoracic Appendages	Legs					
	Wings					
Kinds of locomotion						
Mouth-parts						
Antennae						
Eyes						
Economic Importance						

In what respects do all these animals agree?

VIII. *Economic Studies.* (Exercises 34-55.)

Purpose: To make a practical application of zoological studies to human welfare and thus to strengthen the hold of zoology on the pupil through its human interest; to give knowledge that may be of direct practical utility; to reveal to the student the sources of our information of economic zoology, and to acquaint him with the work of our state and national bureaus and laboratories.

Method: All of these studies call for (1) actual observations by the pupil in the field; (2) inquiries of local experts—as farmers, stockmen, gardeners, orchardists, etc.; and (3) references to the libraries. In each case the general facts of advantage or disadvantage, the facts relating to the care of, or protection against, and the zoological place, should be brought out in such a way as to bind together the scientific and the practical aspects of the problem. Unless there is abundance of time, only those studies should be undertaken in which the student can reasonably hope to get, promptly, enough facts to reward his search. Further emphasis may be given to this matter by co-ordinating it with the study of the groups through the year. Some teachers prefer to do the economic work in the latter way solely.

Ex. 34. Economic Studies: Introduction. Finding out and utilizing all the student's present knowledge of economic values of animals. Enumeration and systematic classification of these values.

Ex. 35. Domesticated Animals. The main facts.

Ex. 36. Comparison of Domesticated Animals. (Tabular.)

Ex. 37. Pests of House and Barn. The main facts.

Ex. 38. Comparison of Household Pests. (Tabular.)

Ex. 39. Animals Producing Disease. The main facts.

Ex. 40. Comparison of Disease-Producing Animals. (Tabular.)

Ex. 41. Animals of the Garden. Main Facts. (Suitable for calendar study.)

Ex. 42. Comparison of Animals of the Garden. (Tabular.)

Ex. 43. Animals of the Orchard. Main facts. (Suitable for calendar study.)

Ex. 44. Comparison of Animals of the Orchard. (Tabular.)

Ex. 45. Animals in Relation to Field Crops. (Suitable for calendar study.)

Ex. 46. Comparison of Animals Affecting Field Crops. (Tabular.)

Ex. 47. Pests of Stored Seeds, Fruits, and Grains. Main facts.

Ex. 48. Pests of Shade and Forest Trees. (Suitable for calendar study.)

Ex. 49. Comparison of Animals Destructive of Trees. (Tabular.)

Ex. 50. The Food-Yielding Animals. Main facts.

Ex. 51. The Animals Yielding Clothing to Man. Main facts.

Ex. 52. Comparison of Animals Furnishing Clothing. (Tabular.)

Ex. 53. Pets. A general study of the problem; the special types that have been so used; a detailed study by each student of some pet species, and its history.

Ex. 54. Animal Industries. A study of the organized human industries based on animal life. Some of the facts, with the zoological foundations for them.

Ex. 55. Comparison of Animal Industries (Tabular), as to human importance, geographical distribution, etc.

IX. *Studies of the Essentials of Living Matter.* (Exercises 56-57.)

Purpose: To enable the student better to get a notion of the machinery on

which life depends, and of the real size, shapes, appearance, and powers of the cells, which are conveniently thought of as units of living matter.

Method: Demonstrations and studies of stained and unstained cells under the compound microscope, together with a study and comparison of all the figures of cells and tissues that can be found.

Ex. 56. Study of Single Cells. Microscopic study of cells, whole and in sections, showing characteristic parts. Dividing cells.

Ex. 57. Study of Cells in Union. Tissues. Demonstration and discussion of some representative tissues.

X. *Study of Types Illustrating the Evolutionary Series.* (Exercises 58-94.)

Purpose: To give the student a systematic view of the animal kingdom which can be had in no other way than through a progressive study of some representatives of the more important phyla; to enable him to realize the relation of increasing complexity of structure to increased efficiency of functioning, as one passes from the lower to the higher; to heighten his sense of the unity of animal life; to enable him to expand the type of the phylum by comparing other members of the phylum with it.

Method: In all the studies of this series it will be understood that physiology, morphology and ecology will be mingled. It is not the purpose to give mastery of many details of structure, but rather to enable the student to realize the animal as a living machine with certain necessary adjustments to make and certain structure to make them with. There is no purpose of making a sharp analysis of the work into morphology, ecology, and physiology.

Ex. 58. Introductory Examination of Cultures for Protozoa.
Ex. 59. Paramecium. Activities and form.
Ex. 60. Comparison of Various Protozoa. (Tabular: laboratory and library.)
Ex. 61. Sponges.
Ex. 62. The Simple Metazoa: Hydra.
Ex. 63. Hydra (continued).
Ex. 64. Coelenterata Compared. (Tabular.)
Ex. 65. The Simple Metazoa: Flatworms.
Ex. 66. Comparison of Parasitic Worms. (Tabular: library.)
Ex. 67. The Starfish.
Ex. 68. Comparison of Echinoderms. (Tabular.)
Ex. 69. The Earthworm: Habits and Powers; Economic Values.
Ex. 70. The Earthworm: Form and External Structure.
Ex. 71. The Earthworm: Internal Functions and Organs.
Ex. 72. Comparison of Segmented Worms. (Tabular.)
Ex. 73. A Clam (or Snail).
Ex. 74. Comparison of Molusks. (Tabular.)
Ex. 75. A Fish: Habits and General Form.
Ex. 76. Fish; Activities and Powers; Special External Structures.
Ex. 77. Comparison of Fishes. (Tabular.)
Ex. 78. The Frog: Habitat and Habits; Activities in Laboratory.
Ex. 79. The Frog: General Form, Structure, and Development.
Ex. 80. The Frog: Skin, muscles, visceral organs—structure and functions.

Ex. 81. Comparison of Amphibia. (Tabular.)
Ex. 82. Reptiles: Study of General Characteristics. Field and library work.
Ex. 83. Comparison of Reptiles. (Tabular.)
Ex. 84. Birds: Varieties, Habitats, Noteworthy Habits.
Ex. 85. Birds: Other Activities and Powers.
Ex. 86. Birds: General External Form and Structure.
Ex. 87. Comparison of Birds. (Tabular.)
Ex. 88. Mammals: Introduction. General characteristics; varieties.
Ex. 89. Mammals: Field and Laboratory Work. Habits, powers, distinctive structure.
Ex. 90. Man as a Mammal. General Animal Habits and Activities.
Ex. 91. Man as a Mammal. Form of body; structure of internal organs.
Ex. 92. Comparison of Mammals. (Tabular.)
Ex. 93. Comparison of Vertebrates. (Tabular.)
Ex. 94. Comparison of Animals. (Tabular.)

XI. *Studies in the Life History of Animals.* (Exercises 95-107.)

Purpose: To enable the student to realize the simple way in which organisms start life and the steps whereby they reach maturity; to make clear the meaning of the life-cycle; to enable him to realize something of the meaning of reproduction and development among human beings.

Method: The time available will not allow each pupil to study even casually all the exercises in this section. It is suggested rather that all shall study Exercises 95-97, and that others chosen shall be divided among the students. Reports of all those individual studies should be made to the class, and all members should make the tabular comparison. These subjects are also suited to be calendar studies.

Ex. 95. Reproduction in Lower Forms: Protozoa, Hydra, etc.
Ex. 96. Reproduction in Higher Forms: Frog, Bird, etc.
Ex. 97. Reproduction in Mammals, including Man.
Ex. 98. Life History of Animals: Sea Urchin (Early Stages).
Ex. 99. Life History of Snail. Eggs, fertilization, development.
Ex. 100. Life History of Mosquito. Egg laying, fertilization, metamorphosis, etc.
Ex. 101. Life History of Blow Fly.
Ex. 102. Life History of Butterfly (or Moth).
Ex. 103. Life History of Potato Beetle.
Ex. 104. Life History of Spiders.
Ex. 105. Life History of Frogs or Toads.
Ex. 106. Early Life History of the Chick.
Ex. 107. Comparison of Life Histories. (Tabular.)

XII. *Studies in the Life Relations of Animals.* (Exercises 108-118.)

Purpose: To enable the student to see at first-hand, how living objects are adjusted to some of the chief features of their environment; to discover what the really vital relations are; and to give him a better practical foundation for understanding what is found in the books on the subject.

Method: The student should combine the field, laboratory, and the library in these studies. A series of representative animals should be chosen, and their

relation to the various environmental factors observed and recorded. Portions of this work may be done in connection with the study of the typical animals suggested in Section X.

Ex. 108. Introductory. An enumeration and classification of the influential conditions of life with which the students are already somewhat familiar; fundamental and secondary conditions.

Ex. 109. Food and the Food-Relation. Organs for food capture; senses involved therein; choice of food; storing of food, etc.

Ex. 110. Relations to Moisture and Drouth. Adaptations to life in water, in moist places, in drouth, etc.; and to the use and retention of moisture internally.

Ex. 111. Relation to Temperature. Sense of temperature; bodily heat; special adaptions to changing temperature.

Ex. 112. Relation to Light. Sensitiveness to light; light and darkness lovers; perception and influence of color; seeing objects; eyes.

Ex. 113. Relation to Gravity and to the Density of the Medium. Gravity in relation to the normal position of animals; form of the body in relation to gravity; specific gravity in animals in relation to the medium in which they move. Effects of these things on animal organization.

Ex. 114. Relation to Sound. Nature of sound and the process of hearing in various grades of animals. Points of uniformity and of difference in the sound-receiving organs.

Ex. 115. Relation to Offspring. Various ways and degrees of care of offspring. The meaning of it in evolution.

Ex. 116. Relation to other Members of Same Species. Relations of mates; voluntary association, etc.

Ex. 117. Relations of Animals of Different Species: helpful, hurtful, and indifferent.

Ex. 118. Relations to Plants. Plant-eating animals; plant homes for animals, insects, and flowers, etc.

XIII. *Studies Relating to Variation, and Evolution.* (Exercises 119-129.)

Purpose: To introduce the student systematically to one of the most interesting of the modern aspects of the subject, and to give him a foundation in his own observations by means of which he may the better appreciate the literature dealing with it.

Method: Direct observations, supplemented by reference work.

Ex. 119. Study of Variations in Man. Kinds and amounts of variations found among humans; that found in one family, etc.

Ex. 120. Variations in Poultry. Quality and quantity of variations within a breed; among breeds, sources of variations.

Ex. 121. Comparison of Varieties of Domestic Fowl. (Tabular.)

Ex. 122. Variation in Wild Species.

Ex. 123. Inheritance in Man. A study of the kinds of things that are inherited.

Ex. 124. Inheritance in Domestic Animals. Observed facts of.

Ex. 125. Inheritance in Wild Species. Comparison of inherited and acquired qualities.

Ex. 126. Rate of Multiplication in Animals. Possible increase; actual increase.

Ex. 127. Rate of Multiplication. Inorganic forces that keep down population; organic enemies; cite own observations.

Ex. 128. Adaptation. Effects of cross-breeding and human selection of animals; effects of natural forces on animals in the long run.

Ex. 129. Adaptation among Humans. Through inheritance (eugenics); through environments (euthenics).

XIV. *Studies of certain interesting and extraordinary adaptations among animals.* (Exercises 130-142.)

Purpose: To introduce the student in a systematic way to some of the more striking and spectacular facts of animal life; to add to the general interest and appreciation of the child in the animal kingdom; to suggest subjects for popular interest and reading after the course is finished.

Method: A large part of this work will necessarily be library work, and yet in each exercise the student should be urged to record the main facts of his own knowledge and observation first. A few of them lend themselves to experiment and measurement. It is probable that an increase of general interest could be secured in most classes by assigning these subjects at intervals during the course rather than by reserving them all for the end of it.

Ex. 130. Beauty among Animals. Examples of; the elements that contribute to beauty in different species.

Ex. 131. Size of Animals. Range of size within a species; among different species. Facts concerning peculiarly large and peculiarly small types.

Ex. 132. Strength in Animals. Methods of testing. Record of some results of testing and of reading.

Ex. 133. Rate of Motion. Measurements; records; interpretation in respect to general habits and conditions of life.

Ex. 134. Weapons of Animals. Study of the kinds, position, degree of development, manner and purpose of using, etc.

Ex. 135. Migrations. Local studies and references; times of year, direction, causes of, manner of, etc.

Ex. 136. Mating Habits of Animals. Differences between males and females, in structure and disposition, and the reasons therefor; courtship; types of mating.

Ex. 137. Home-Making among Animals. Types and purposes of homes; careful study of some particular types.

Ex. 138. Industries of Animals. Animals that play or work spontaneously; nature and value of these activities.

Ex. 139. Co-operation among Animals. Observed and recorded instances of animals of the same species working together in a co-operative way to accomplish results; of different species.

Ex. 140. Community Life. The degree of closeness of the social life of the members of some familiar species of animals; of foreign species of animals.

Ex. 141. Parasitism. The facts in the life history of at least one or two parasites. The general conditions and results of parasitism. A table of parasites, their hosts, diseases they produce, and the phylum to which the parasite belongs.

Ex. 142. States of Activity and Rest. Relation of activity and rest in man and other known animals. Fatigue, rest, sleep, restoration; their physiology.

V.

THE PROGRAM OF STUDIES.

Frequently the request comes for a model "course of study" for a given high school. The University has refrained from offering such a model or models lest these become fixed types and impede the progress of readjustments which become necessary from time to time. At the same time it is recognized that the practice so common among smaller high schools of radically changing the program (course) of studies from year to year is greatly to be deplored. It is one of the great causes of irregularity and inefficiency in this type of schools, and school authorities would do well to avoid such frequent and commonly unnecessary changes.

Another cause of weakness is to be found in the effort to make the program of studies include too much for the teaching force or the material equipment of the school. In this effort recourse is frequently had to some plan of alternation by which two high school grades are thrown together in the same subject. This is a practice which can be safely indulged in only to a very limited extent in high school work.

As previously stated (p. 12) the University requires three teachers as a minimum for accrediting a four year high school. These three teachers, one of whom is principal of the school, should not carry more than the sixteen recitations included in a straight four year, four subject program. Not more than two alternations can be permitted in such cases, and the school would, in most instances, be better off without these. This would permit the offering of only two electives.

The following suggestions are offered as a basis for arranging a program (course) of studies for a four year high school employing the teaching time of three or more teachers:

GROUPING OF SUBJECTS BY GRADES

First Year.	Second Year.
*English	*English
*Algebra	*Plane Geometry
History, Ancient	History, European
Physical Geography ½ yr.	Zoology ½ yr.
Botany ½ yr.	Physiology ½ yr.

First Year	Second Year
Latin	Latin
German	German
French	French
Drawing and Art Work	Drawing and Art Work
Manual Training	Maual Training
Business Training	Business Training
Domestic Science	Domestic Science
Agriculture	Agriculture
Music	Music
Physical Training	Physical Training

Third Year.	Fourth Year.
*English	English
History, English or European	American History ½ yr.
Chemistry or Physics	Civics ½ yr.
Solid Geometry ½ yr.	Physics or Chemistry
Advanced Algebra ½ yr.	Economics ½ yr.
Latin	Trigonometry ½ yr.
German	Latin
French	German
Spanish	French
Commercial Geography	Spanish
Business Training	Drawing and Art Work
Manual Training	Manual Training
Drawing and Art Work	Business Training
Domestic Science	Domestic Science
Agriculture	Pedagogy or Educational Psychology
Music	Agriculture
Physical Training	Music
	Physical Training

It will be seen that all subjects usually offered in high schools are hereby included. The starred subjects, with one unit of science (either Physics, Chemistry, Botany, Zoology or Physiology, with laboratory work), are required for admission to all courses in the University. These together with additional subjects required by particular colleges or departments of the University should be kept in mind where a school is desiring to become accredited. (See Admission Requirements, pp. 7-8).

In making up a program for a three teacher school enough subjects (besides those prescribed) should be selected from each year group to make up not to exceed 18 units for the four years. If any additional election should be desired this may be managed by making

it class election instead of individual, assuming that the teachers are prepared to handle the subjects chosen. For instance, the choice might be between two languages. The language which the class as a whole, or which a majority would elect, would be the one taught for a given year or more. In a similar way vocational work might be handled, subject to limitations as to equipment and teaching ability. A certain amount of work in music and physical training may be permitted as extra. Such a plan may be used so as materially to increase the flexibility of a program of studies for a small high school.

As the number of teachers increases there may be an increase in individual election, but always with the increase in enrollment and consequent dividing of grades into sections as a controlling factor.

School authorities, in introducing new courses, such as commercial, manual training, domestic science, agriculture, should take into consideration their ability to equip properly for them and also the difficulty of providing competent instructors. Courses which are only in the experimental stage, such as general science, should be left to the stronger schools which can afford the experiment until some definite conclusion is reached as to what such a course should be and where it should come in the program.

Programs of studies for two-and-three year high schools may be made up from the above grouping by grades. In such cases, also, the limitations as to time, equipment, and qualifications of teachers should be carefully observed.

VI.

SUGGESTIONS FOR THE EQUIPMENT OF LABORATORIES.

Primarily this problem should be considered in the plans for building a high school. Important considerations in connection with building plans are: 1. The proper lighting of rooms to be used for various laboratory purposes. Where the microscope is to be much in use a north light, and an abundance of it is desirable. In the matter of preserving life forms for biological work, on the other hand, direct sunlight is desirable.

In a physical laboratory there is need of direct sunlight in connection with the study of light. Otherwise the light should be ample for close observation in experiments.

In rooms used for drawing and art work a north light should be planned unless overhead light is possible. The latter is the ideal light for such work.

2. The building in of suitable cases, cupboards, etc., for taking care of apparatus and supplies.

3. Equipment with good substantial tables for experimental work.

4. The provision of good ventilation, and of hoods to take off gases and fumes from the chemical laboratory.

5. Convenience of water supply, with lavatories and sinks, and with aquaria in the biological department.

6. A gas plant should be provided for chemistry, and is practically indispensible where domestic science is to be included in the program.

LABORATORY APPARATUS.

Physics: This should be selected on the basis of experiments to be undertaken, as suggested in the syllabus, p. 64. The aim should be to provide as far as possible for individual work. Hence it is that the amount and cost will vary with the number of pupils to be supplied and the number of experiments to be undertaken. Whatever is bought will need to be replenished from year to year as such material tends to become rapidly depleted.

Chemistry: The same general principles apply as in physics. In both cases it is a good plan to determine on the extent and nature of the experimentation and then submit lists of experiments to reliable houses with request for prices of apparatus and materials necessary.

Biology: This includes Botany, Zoology, and Physiology. The laboratory should be provided with dissecting instruments and simple microscopes. There should also be as many compound microscopes of good grade as would be necessary to provide one for each group of four or six. If practicable there should also be a good lantern with projecting microscope attachment.

The following report on Illustrative Materials for High School Biology Courses given it the Conference for 1914 is of special value for its helpful suggestions:

Your committee, appointed to make recommendations as to the illustrative materials with which high schools should be supplied in order to give in a satisfactory way the courses in Botany and Zoology, beg to make the following report:

1. We desire to express our conviction that every school should, regularly and with some system, undertake to build itself up in this regard. By following this practice thru a period of years any school may supply itself with the minimum necessities, without financial strain.

2. It is possible, for convenience, to divide the illustrative necessities into two main groups:—(a) those that must be purchased outright, and (b) those that may be made gradually by students of successive classes, if only they are supplied with the necessary raw materials. This latter group is somewhat larger than we may at first sight believe. Furthermore, whenever it is possible for some such materials to be made by students the very making may become a means of increasing interest and of giving fuller meaning to the course.

3. We desire also to insist that most teachers do not use as fully as they should the supply of illustrative material which nature affords. The individual work in fields and forests, in swamps and in the waters, in parks and gardens, in green-houses and zoological gardens furnishes a means of illustrating courses which our formal use of the laboratory and class room cannot at all replace.

4. In detail we make the following suggestions as to what should be held in the mind of the teacher of Biology and the directors of schools as an objective:—

a. *Museums.* Small synoptic collections illustrating the main phyla and classes of animal kingdom and the main groups of plants are very valuable. These should not be large and should be built up by successive classes, teachers, and friends of the school rather than got by purchase. Money should go into the cases, containers, and preserving materials, rather than into specimens. It will be necessary to buy some specimens,—as sponges, corals, and other sea forms. Aside from such synoptic collections, built up by successive classes, two particularly interesting lines of addition are open to the museum of a high school: (1) considerable numbers of certain kinds of objects (e. g. snail shells, or leaves, or insect species) arranged, to illustrate the *range of variation,* may be mounted for display; (2) skeletons may be prepared and mounted, or other specially excellent dissections by members of a class may be preserved. Such original contributions by students may well be labeled and credited to the student preparing it. Such a museum does not need to be large to be exceedingly valuable; but it should be fairly representative and synoptic.

b. *For living materials, plant and animal.* Some green-house facilities, if only a sunny window, for winter use, and outdoor beds for spring, are desirable for first-hand supply of botanical material. A corner in the local greenhouse can often be rented.

There should be one aquarium of some size, if possible with running water. A number of battery jars or other glass vessels of various sizes, insect cages, life-boxes, and the like are essential. Students can make many of these boxes and cages, and even small wood aquaria with one or more glass sides. A small fund should be set apart for such purposes and be available without unnecessary delay. All these things are valuable to insure having organisms when they are needed, to allow experiments and continued observations on habits, and to allow study of development. The library should have at least one good book containing suggestions for making such apparatus and the care of living animals. We commend Ganong's "Teaching Botanist" as an aid in the organization of the museum and in other respects. If the school room is not kept heated at night these life supplies may be kept in a suitable basement room during the coldest weather.

c. *The local collection of living materials.* We feel that something is lost if classes are not encouraged to collect as much of the needed local material as possible for themselves. Field work should be so organized that at least some of this shall be done. In connection with this sort of work a home-made map, drawn to suitable scale, of the locality for several miles around the school may be perfected, if the locality at all lends itself to this treatment. All important topographic points that have to do with plant and animal life should be located. The roads, streams, springs, ponds, and other special habitats of specially interesting plants and animals should be indicated. There should also be a card catalog or indexed book in which are inserted the locality on the map where special types of plants and animals are discovered from year to year. In a few years such an arrangement will illustrate some of the local facts of geographic distribution, as well as be an aid to each incoming class in finding what it needs. It will be necessary always to purchase some materials for laboratory, and museum work. We cannot publish a complete list of dealers; but the following are reliable:

A. A. Sphung, North Judson, Ind. Live or preserved frogs, crayfish, turtles, etc.

H. M. Stephens, Dickinson College, Carlisle, Pa., Zoological and Botanical materials for class use.

C. S. Brimley, Raleigh, N. C., Reptiles, Amphibians, and Fishes, living or preserved. A good reference for the winter months.

Biological Supply Co., 106 Edgerton St., Rochester, N. Y. Plant and animal materials for laboratory; slides.

Marine Biological Laboratory, Woods Hole, Mass. Preserved materials for Botany, Zoology and Embryology.

Saint Louis Biological Laboratory, St. Louis, Mo. Microscopic and Lantern Slides.

d. *Microscopes.* If microscopes are used only for demonstration purposes there should be at least two good standard instruments with powers ranging from 50-500, so that both low and medium power views can be shown at the same time. There should also be one oil-immersion objective for occasional high power demonstrations.

If microscopes are to be used as a regular part of the laboratory work, as we feel they should be, there should be *at least* enough to supply each pair of pupils in the largest section with one complete, standard instrument. We believe that no laboratory section in Biology should contain more than 24 members for one instructor. Twelve microscopes can be made to serve such a section.

There should be a simple dissecting microscope for each pupil or each pair of pupils.

e. *Microscopic slides.* These may be divided into four groups: (1) temporary slides, which teachers and pupils may make freely. The teacher should become expert in making these and enabling his pupils to do so; (2) permanent mounts of interesting objects small enough to be stained and mounted whole. There are very many such which are valuable. It should not be necessary to purchase these. The teacher should be supplied the necessary material and learn to make, stain, and mount these; (3) temporary or permanent mounts where free-hand sections may serve all necessary ends. The teacher should be able to make, stain, and mount these; and (4) permanent mounts of materials where expensive apparatus is necessary for imbedding, sectioning, grinding, etc. These can be bought much more cheaply than made, and the apparatus necessary to make them is hardly to be sought in the ordinary high schools.

We append a suggestive list of especially valuable microscopic slides that should be purchased and used at least as demonstrations in high school courses. These should be the best of their kind,—clear, typical, and perfectly stained.

1. Cell structures, cell-arrangement, and cell-division as seen in longitudinal section of root tip of *Tradescantia or Hyacinth.*
2. Cross-section of leaf, showing structure of this basal organ of all nutrition.
3. Cross and longitudinal sections of monocotyledonous and dicotyledonous stems.
4. Cross-section of a root.
5. Cross-section of ovary of lily or other suitable plant, showing relation of the parts.
6. Longitudinal section of young flower or leaf bud showing the beginning of floral parts, or of the foliage suits.
7. Section of another showing pollen-formation.
8. Longitudinal section of pollinated pistil showing pollen tubes, etc.
9. Some properly stained bacteria,—as *Spirillum, Bacterium, Baccillus,* etc.
10. Section of hymeniun of Ascomycete and Basidiomycete.
11. Cleavage, morula, and gastrula of some form like the starfish.
12. Sections of tadpoles of 1 to 3 weeks to show how animal cells come to be related in tissues and organs, as well as the relations of the organs. Good to compare with (1).
13. Cross and longitudinal sections of *Hydra.*
14. Section thru vertebrate eye in visual axis.
15. Section of compound eye in axis of ommatidium.
16. Longitudinal and cross section of bone.
17. Longitudinal section of tooth.

18. Cross-section of stomach or intestine, showing coats, glandular-absorptive surface, etc.
19. A Golgi preparation showing ramifications of neurons.
20. Section thru skin of animal.
21. Section of injected liver.
22. Ciliated cells.
23. Cross and long (several segments) sections of earthworm.

f. *Projection apparatus.* We believe that a projecting lantern with opaque projector and a projecting microscope should in time be provided for each high school. The usefulness of such a lantern would not of course be confined to the courses in Biology. This would demand also the gradual accumulation of a limited number of well selected lantern slides and microscopic slides.

g. *Illustrative books.* So much success has attended photography, both gross and microscopic, and the reproduction of these pictures in books that every school should supply itself with some books illustrating natural history to aid in identifying the plants and animals discovered by the classes and in visualizing such as the student may not be able to find in his own locality. Under this head comes illustrated natural histories, flower-books, bird-books, butterfly-books, the reptile book, and the like,—as well as some larger texts showing figures of dissections and microscopic structures in plants and animals.

h. *Charts.* Very effective charts for both Botany and Zoology are issued by a number of firms. These are valuable, but expensive. Each school should perhaps have a limited number of these charts illustrating certain features of life not readily illustrated in some other ways.

Of even more value, however in some respects, are home-made charts, drawn from figures and tables in books and periodicals. They may be made on paper or on paper reinforced by cloth. They may be mounted on a roller or kept flat. Ingenious devices to display them can be made by the pupils themselves. Ink may be used, put on with a brush, or colored crayons may serve. A spray of shellac, from an atomizer after the crayon marks are made, will keep the crayon from spreading. There is almost no limit to the number of charts,—of lines or simple shaded surfaces,—which classes and teachers may make by copying figures from books, nor to the help they render in making structures clear. The selection and making of such charts with their lettering and interpretation is very valuable work for the pupils. The school should furnish the materials for making these charts.

i. *Blackboard drawings as illustrative material.* The committee desires to emphasize the importance of the ability of the teacher to make simple freehand diagrams before the class. Every teacher should give time to cultivate this power to his full capacity, and to use whatever drawing ability the members of the class may have. These diagrams should not be made too complex. They are valuable because of their simplicity and the consequent emphasis on essentials, and on the fact that they grow under the eyes of the pupils.

T. W. Galloway,
Clarence Bonnell,
E. N. Trauseau,
Committee.

Geography. For this work there should be plenty of good government survey charts giving topography. There should also be thermometers, barometers and other apparatus for observing and recording weather conditions. A good commercial cabinet will help to bring before the pupils in concrete forms the leading commercial products.

Agriculture: The apparatus will be determined by the courses to be offered and can not, therefore, be estimated. See 1914 Conference Proceedings, pp. 109-110, for valuable suggestions as to materials. See also p. 84, Proceedings of 1913.

When it has been fully settled as to the course or courses to be offered it is suggested that treatment similar to that recommended for physics and chemistry be followed. The Wm. Welch Co., and Central Scientific Co., are among those prepared to furnish quotations on apparatus for agriculture.

Manual Training: For this there will need to be individual or bench equipment and a general equipment. The minimum cost of bench equipment, including bench, will be about $16.00 to $18.00. The corresponding general equipment would be about $75.00 for twenty pupils. The range of cost above this to a very liberal equipment will be about $35.00 for individual desk, and $215.00 general for twenty pupils.

Drawing: For both mechanical and free-hand drawing suitable tables should be provided. There are many varieties and prices. Ordinarily pupils are required to get their own sets of instruments, pencils, crayons, colors, etc. Whether these are purchased by the school or by the pupils, good varieties should be selected and designated for use of the school.

Domestic Science: Like agriculture the equipment will be determined by the courses to be offered

Bookkeeping: This will require a room well lighted, preferably without direct sunlight. There will also need to be desks selected, or large tables, suitable for use in handling the various books and papers.

DEALERS IN APPARATUS AND SUPPLIES FOR LABORATORIES.

C. H. Stoelting Co., 121 North Green St., Chicago;
Central Scientific Co., 412 Orleans St., Chicago;
Chicago Apparatus Co., 40-42 West Quincy St., Chicago;
Wm. Gaertner & Co., 5347-9 Lake St., Chicago;
Henry Heil & Co., 212-214 South Fourth St., St. Louis, Mo.;
Eimer & Amend, 205-211 Third Ave., New York City;
L. E. Knott Apparatus Co., Harcourt St., Boston, Mass.;
E. H. Sargent & Co., 143-145 Lake St., Chicago;
Bausch & Lomb Optical Co., Rochester, New York;
McIntosh Stereopticon Co., 35-37 Randolph St., Chicago;
Kewanee Manufacturing Co., Kewanee, Wis. (laboratory furniture);
Leonard Peterson & Co., 1240-1248 Fullerton Ave., Chicago, (laboratory furniture.)

DEALERS IN SUPPLIES AND EQUIPMENT FOR SHOP WORK AND MECHANICAL DRAWING

Simmons Hardware Co., St. Louis, Mo.;
Orr & Lockett Hardware Co., 71-73 Randolph St., Chicago;
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York City.
E. Dietzgen Co., Chicago; Weber & Co., St. Louis; A. S. Aloe Co., St. Louis.

VII.

THE HIGH SCHOOL LIBRARY.

In the larger schools it will be well to have a library room with suitable book-stacks, shelves for general reference works, etc. In the smaller schools a corner, or side, or possible the rear of the study room may be utilized for library purposes. Even in moderately large schools this plan works very well. One recently constructed high school has book shelves placed along one side of the study room and the pupils seated about tables for study, thus facilitating the ready and frequent use of books referred to by the teachers.

For the regular work of the high school two classes of reference books are needed: First are the general reference works, such as encyclopedias, dictionaries, ready reference books, atlases and statistical compendiums and reports. Then there are the special reference works for the different departments of high school work, selected in order to give opportunity for rather extensive collateral reading on important or controverted topics of the text-books. No department of high school work should be without its list of such books. These books should be kept in the general study room or library rather than in rooms assigned to the respective departments for class work. This is desirable, if for no other reason than the fact that there are frequently cross references necessary from one department to the literature of another.

The following lists of books are only tentative. It is hoped that the various Conference sections will take up this matter of listing the best books in each department. This should mean not only the careful preparation of initial lists, but also additions and eliminations from year to year. To do this each section would need a standing committee, one to three members, on literature of the subject represented.

GENERAL REFERENCE BOOKS FROM WHICH TO SELECT.

Encyclopedias: New International Encyclopedia, Dodd. American Encyclopedia, Latest Edition.

New Gazettier, Lippincott.

Familiar Quotations, Bartlett, Little.

Dictionary of National Biography, Stephen & Lee, 22 vols. Macmillan.

Dictionaries: Webster's New International, Merriam. New Standard, Funk & Wagnalls.
Rand-McNally's *Indexed Atlas of the World*, 2 vols.

ENGLISH.

English Literature

I. Introductory.—
Corson, Hiram
The Aim of Literary Study, Macmillan.....$ .75
Bates, Arlo
Talks on the study of Literature, Houghton, Mifflin & Co. 1.50
Hunt, T. W.
Literature, its Principles and Problems, Funk & Wagnalls..... 1.50
Gayley, C. M.
Classic Myths in English Literature, Ginn & Co..... 2.00
Bradish, Sarah P.
Old Norse Stories, American Book Co..... .45
II. History.—
Trent, W. P.
American Literature, Appleton..... 1.50
Stedman, E. C.
Poets of America, Houghton, Mifflin & Co..... 2.25
Saintsbury, G.
A Short History of English Literature, Macmillan..... 1.50
Crawshaw, W. H.
The Making of English Literature, Heath..... 1.25
Newcomer,
Introduction to English Literature, Scott, Foresman & Co..... 1.25
Stedman, E. C.
Victorian Poets, Houghton, Mifflin & Co..... 2.25
III. Anthologies.—
Stedman and Hutchinson,
Library of American Literature, 11 vols.....
Stedman, E. C.
An American Anthology, Houghton, Mifflin & Co..... 3.00
Page, C. H.
Chief American Poets, Houghton, Mifflin & Co..... 1.75
Ward, T. H.
The English Poets, Macmillan, 4 vols..... 4.00
Stedman, E. C.
Victorian Anthology, Houghton, Mifflin & Co..... 2.50
Page, C. H.
British Poets of the Nineteenth Century, Sanborn..... 2.00
IV. Versification.—
Gummere, F. B.
A Handbook of Poetics, Ginn & Co..... 1.25

Alden, R. M.
English Verse, Holt 1.00

V. Types.—
Cross, W. L.
The Development of the English Novel, Macmillan 1.50
Perry, Bliss
A Study of Prose Fiction, Houghton, Mifflin & Co 1.25
Raleigh, Walter
History of the English Novel, Scribner 1.25
Sargent and Kittredge
English and Scottish Popular Ballads, Houghton, Mifflin & Co 3.00
Gummere, F. B.
Old English Ballads, Ginn & Co ..... .80
Woodbridge, Elizabeth
The Drama, Its Law and its Technique, Allyn and Bacon 1.00
Schelling, F. E.
Elizabethean Drama 1558-1642, Houghton-Mifflin & Co 7.50

VI. Individual Authors.—
Pollard, A. W.
Chaucer, Primer, Macmillan ..... .25
Dowden, Edward
Shakespeare, Primer, American Book Co ..... .35
Rolfe, W. J.
Life of Shakespeare, Macmillan 1.25
Lee, Sidney
Life of Shakespeare, Macmillan 1.00
Raleigh, Walter
Shakespeare, Macmillan ..... .40
Rolfe, W. J.
Shakespeare the Boy, Harper 1.25
Neilson, W. A., Editor,
Shakespeare's Works, Houghton, Mifflin & Co 3.00
Furness, H. H., Editor,
Macbeth and the Merchant of Venice, Lippincott, each 4.00
Van Dyke, Henry
The Poetry of Tennyson, Scribner 2.00
Corson, Hiram
Introduction to Browning, Heath 1.00

VII. Topography.—
Higginson, T. W.
Old Cambridge, Macmillan 1.25
Stevenson, R. L.
Edinburgh, Picturesque Notes, Scribner 1.40
Hutton, Lawrence
Literary Landmarks of London, Harper 1.75

VIII. Pedagogical.—

Chubb, Percival

The Teaching of English, Macmillan..... 1.00

Hinsdale, B. A.

Teaching the Language Arts, Appleton..... 1.00

Carpenter, Baker and Scott

The Teaching of English, Longmans..... 1.50

English Composition

Grammar:

Buehler, H. G., A Modern English Grammar with Composition, Newson .65

Carpenter, G. R., English Grammar, Macmillan..... .75

Kittredge and Arnold, The Mother Tongue, Book II, Ginn & Co..... .60

Rhetoric:

Herrick and Damon, Composition and Rhetoric, Scott, Foresman & Co.. 1.00

Hill, A. S., Principles of Rhetoric, American Book Co..... 1.20

Scott and Denny, Elementary English Composition, Allyn and Bacon.. .80

Structure:

Arlo Bates, Talks on Writing English (both series) Houghton, Mifflin & Co.....$1.50 and 1.30

Hammond Lamont, English Composition, Scribner..... 1.00

Scott & Denny, Paragraph Writing, Allyn & Bacon.....

Barrett Wendell, English Composition, Scribner..... 1.50

Woolley, E. C., Handbook of Composition, Heath..... .50

Forms of Prose Literature:

Brewster, Specimens of Narration, Holt..... .50

Nettleton, G. H., Specimens of the Short Story, Holt..... .50

Baldwin, C. S., Specimens of Prose Description, Holt..... .50

Hammond Lamont, Specimens of Exposition, Holt..... .50

Baker, G. P., Specimens of (Modern) Argumentation, Holt..... .50

Nutter, Hersey, and Greenough, Specimens of Prose Composition, Ginn 1.25

Lewis, E. H., Specimens of the Forms of Discourse, Holt..... .60

Cairns, W. B., The Forms of Discourse, Ginn..... 1.15

GEOGRAPHY.

Physiography for High Schools, Arey, Bryant, Clendenin and Morrey, D. C. Heath & Co.

Elementary Physical Geography, W. M. Davis, Ginn & Co.

High School Geography, Charles R. Dryer, American Book Co.

Elements of Physical Geography, Hopkins, Sanborn & Co.

Physiography for High Schools, Salisbury, Henry Holt & Co.

Elementary Physiography, Salisbury, Henry Holt & Co.

Modern Geography, Salisbury, Barrows & Tower, Henry Holt & Co.

Elements of Geography, Salisbury, Barrows & Tower, Henry Holt & Co.

New Physical Geography, Tarr, Macmillan & Co.

Man and His Work, A. J. & F. D. Herbertson, Black.

Industrial Studies, U. S., Allen, Ginn & Co.
General Circulation of the Atmosphere, Ridgley, McKnight, Normal, Ill.
Rainfall of the Earth, Ridgley, McKnight, Normal, Ill.
Vegetation Zones of the Earth, Ridgley, McKnight, Normal, Ill.
Commercial Geography, Brigham, Ginn & Co.
Descriptive Geography From Oriental Sources, Herbertson, Oxford University Press, N. Y.
Text-book of Commercial Geography, Adams, Appleton.
Commercial Geography, Gannett, Garrison & Houston, American Book Co.
Geography of Commerce, Trotter, Macmillan.
Commercial Geography, Redway, Scribners.

HISTORY.

General Bibliography

Good lists of books for all the history courses may be found in A History Syllabus for Secondary Schools (Heath, $1.20) prepared by a committee of the New England History Teachers' Association. See also the report of the same association on Historical Sources in Schools; Bourne, Teaching of History and Civics (Longmans, $1.50); and the more recent text books, nearly all of which have carefully prepared and adequate lists.

Ancient History

Abbott, Pericles. Putnam, 1905.....$1.50
Wheeler, Alexander the Great, Putnam, 1900..... 1.50
Fowler, Cæsar, Putnam, 1892..... 1.50
Botsford, The Story of Rome as Greeks and Romans Tell It, Macmillan, 1903 .90
Hodgkin, Dynasty of Theodosius, Clarendon Press, 1899..... 1.50
Emerton, Introduction to the Middle Ages, Ginn, 1892..... 1.12
Fling, A Source Book of Greek History, Heath.....

Medieval and Modern History

Archer and Kingsford, The Crusades, Putnam, 1895..... 1.50
Brown, The Venetian Republic (Temple Primers), Macmillan, 1902..... .40
Symonds, A Short History of the Renaissance in Italy (Ed. Pearson), Holt, 1894 ..... 1.75
Gardiner, The Thirty Years' War (Epochs), Scribner, 1901..... 1.00
Motley, Peter the Great, Maynard, 1893..... .25
Hassall, Louis XIV and the Zenith of the French Monarchy, Putnam, 1899.. 1.50
Gardiner, The French Revolution (Epochs), Longmans, 1902..... 1.00
Dow, Atlas of European History, Holt, 1907.....
Robinson, Readings in European History (One Volume edition), Ginn..... 1.50

English History

Green, History of the English People, American Book Co., 1889..... 1.20
Gardiner, School Atlas of English History, Longmans, 1902..... 1.50

Kendall, Source Book of English History, Macmillan, 1900..... .80
Freeman, Short History of the Norman Conquests, Clarendon Press, 1901... .60
Stubbs, Early Plantagenets (Epochs), Longmans, 1895..... 1.00
Creighton, The Age of Elizabeth (Epochs), Longmans, 1899..... 1.00
Gardiner, The Puritan Revolution (Epochs), Longmans, 1902..... 1.00
Harrison, Cromwell, Macmillan, 1898..... .75
Morley, Walpole, Macmillan, 1899..... .75
Roseberry, William Pitt, Macmillan, 1902..... .75
Oman, England in the Nineteenth Century, Longmans, 1900..... 1.25
Bates and Coman, English History Told by English Poets, Macmillan, 1902.. .80

American History

Larned, Literature of American History (Houghton, $6.00) and Channing and Hart, Guide to the Study of American History (Ginn, $2.00), are important aids in teaching and in collecting books. In Larned, Literature of American History, pages 464 and 465, is an excellent list for a small library in American history. See also the History Syllabus for Secondary Schools, (Heath), pages 279-289. The following are among the more useful books for high school instruction:

Epoch Series. 3 vols., Longmans, $1.25 per volume.
Thwaites, The Colonies, 1492–1750.
Hart, Formation of the Union, 1750–1829.
Wilson, Division and Reunion, 1829–1889.

American Statesmen Series. Houghton, 1898–1900. $1.25 per vol.
(32 volumes in series.)
Lodge, George Washington, 2 vols.
————, Daniel Webster.
Tyler, Patrick Henry.
Morse, Abraham Lincoln.

Riverside Biographical Series. School edition. Houghton, 50 cents per vol.
Merwin, Thomas Jefferson.
Brown, Andrew Jackson.
————, Stephen A. Douglas.

Fiske, Beginnings of New England. Houghton, 1889..... 2.00
————, Critical Period of American History, Houghton 1888..... 2.00
Lecky, The American Revolution (Ed. Woodburn). Appleton..... 1.25
Stanwood, A History of the Presidency, Houghton, 1898..... 2.50

List of Mathematical Books Suggested for a High School Library

Histories

Ball, W. W. R., Primer of the History of Mathematics, Macmillan..... .65
Ball, W. W. R., Short Account of the History of Mathematics, Macmillan.. 3.25
Cajori, History of Elementary Mathematics, Macmillan..... 1.50
Cajori, History of Mathematics, Macmillan..... 3.50

Pedagogic, General

Ball, W. W. R., Math. Recreations and Essays, Macmillan..... 2.25
Clifford, W. K., Common Sense of the Exact Sciences, Appleton..... 1.50
Dedekind, Essays on Theory of Numbers, Open Court, Chicago..... .75
DeMorgan, Study and Difficulties of Mathematics. Open Court, Chicago... 1.25
Fine, Number System of Algebra, Heath..... 1.00
LaGrange, Lectures on Elementary Mathematics, Open Court..... 1.00
Schubert, Mathematical Essays and Recitations, Open Court..... .75
Smith, D. E., Teaching of Elementary Mathematics, Macmillan..... 1.00
Young, J. W. A., Teaching of Mathematics in Elementary and Secondary Schools, Longmans 1.00

Algebra

Chrystal, Algebra, Macmillan, 2 parts each..... 4.25
Fine, College Algebra, Ginn..... 1.50
Gibson, Elementary Treatise on Graphs, Macmillan 1.00
Lodge, Easy Mathematics, chiefly arithmetic, Macmillan..... 1.10
Myers, First Year Mathematics, U. of C. Press..... 1.00
Schulze, Graphic Algebra, Macmillan
Woods & Bailey, Course in Math. First year in College, Ginn.

Geometry

Halsted, Rational Geometry
Hilbert, Foundations of Geometry, Open Court..... 1.00
Klein, Famous Problems in Elementary Geometry, Ginn..... .50
Myers, Geometrical Exercises for Algebraic Solution, U. of C. Press
Rowe, Geometrical Exercises in Paper Folding, Open Court Publishing Co.. 1.00

Periodicals

School Science and Mathematics.
Mathematical Gazette.
Mathematical Monthly.

PHYSICS.

This list is made up of general text-books intended for school use, most of which include or have reference to directions for a course of laboratory work to be done by the pupils:

Allyn & Bacon	Boston and Chicago
High School Physics	Carhart & Chute
University Physics, 2 vols.	Carhart
American Book Co.	New York and Chicago
Physical Laboratory Manual	Adams
Student's Manual of Physics	Cooley

Brief Course in General Physics	Hoadley
Laboratory Manual	Cheston, Dean and Timmerman
Laboratory Manual	Coleman
Electrical Measurements	Hoadley
General Physics	Ames
Theory of Physics	Ames
Ginn & Co.	Boston and Chicago
Manual of Experimental Physics	Nichols, Smith & Turton
A Text book of Physics	Wentworth & Hill
A First Course in Physics	Millikan and Gale
Physical Laboratory Manual	Gage
General Physics	Hastings & Beach
D. C. Heath & Co.	New York and Chicago
Coleman's Elements of Physics	
Cheston, Gibson & Timmerman's Physics	
Physical Laboratory Manual Chute	
Henry Holt & Co.	New York and Chicago
Laboratory Physics	Allen
A Text-book of Physics	Hall & Bergen
Physics	Geo. F. Barker
Scott Foresman & Co.	New York and Chicago
Physics	Mann & Twiss
The Macmillan Co.	New York and Chicago
Elements of Physics	Crew
Elements of Physics	Andrews & Howland
Laboratory Manual of Physics	Crew & Tatnall
College Physics	Nichols
Physics for Schools	Stewart & Gee
Practical Physics	Stewart & Gee
Units and Physical Constant	Everett
Principles of Physics	Daniell
Laboratory Manual	Twiss
Wm. Wood & Co.	New York
Ganot's Physics	
Mumpher's Text-book of Physics.	

See also the list of references published in the reports of Central Association of Science and Mathematics Teachers, 1912, Michigan Physics Conference, 1899, and in Smith and Hall's Teaching of Chemistry and Physics, Longmans, Green & Co., New York, 1902.

List for Teachers

School Science monthly, published, Chicago, Ill.

Zeitschrift fur physicalischen und chemiche Unterricht (G. E. Stechert, N. Y. City, Agent.)

CHEMISTRY.

General Chemistry, Newell.....D. C. Heath & Co.
Descriptive Chemistry, Newell.....D. C. Heath & Co.
Essentials of Chemistry (revised edition), Hessler & Smith.....Sanborn & Co.
Elementary Chemistry, Linebarger.....Rand, McNally & Co.
Introduction to Chemistry (Briefer Course, Remsen).....Henry Holt & Co.
School Chemistry, Avery.....American Book Co.
Elementary Chemistry, Arey.....Macmillan Co.
Elementary Chemistry, McPherson & Henderson.....Ginn & Co.
Elementary Chemistry, Godfrey.....Longmaus, Green & Co.
Chemistry, an Elementary Text-book, Morgan & Lyman.....Macmillan Co.
Inductive Chemistry, Robt. H. Bradbury.....Appleton's Co.
First Principles of Chemistry, Brownlee & others.....Allyn & Bacon
Elementary Chemistry, Alexander Smith.....Century Co.
Foundations of Chemistry, Blanchard & Wade.....American Book Co.

NOTE: Most of the above books have laboratory manuals to accompany them.

BIOLOGY.

Below are given the 25 oftenest mentioned as most desirable reference books for Botany and Zoology respectively. These lists were reported to the 1913 Conference as a result of an inquiry among a wide range of teachers of Biology:

Botany.

1. Nature Study and Life. Hodge.
2. Fungous Diseases of Plants. Duggar.
3. Plant Physiology. Duggar.
4. New Manual of Botany. Gray. Seventh edition.
5. The Teaching Botanist. Ganong.
6. Textbook of Botany. Coulter, Barnes and Cowles.
7. Handbook of the Trees of the Northern States and Canada. Hough.
8. Cyclopedia of Agriculture. Bailey.
9. Care of Trees. Fernow.
10. Our Native Trees. Keeler.
11. Cyclopedia of American Horticulture. Bailey.
12. Experiments with Plants. Osterhout.
13. Practical Botany. Bergen and Caldwell.
14. Plant Breeding. DeVries.
15. Plants. Coulter.
16. Story of Germ Life. Conn.
17. The Nature and Work of Plants. MacDougal.
18. Bacteria in Relation to Country Life. Lipman.
19. Seed Dsipersal. Beal.
20. New Creations in Plant Life. Harwood.
21. Studies of American Fungi. Atkinson.
22. Blossom Hosts and Insect Guests. Gibson.
23. Botany for Schools. Atkinson.
24. Field, Forest and Wayside Flowers. Going.
25. Principles of Botany. Bergen and Davis.

Zoology

1. Handbook of the Birds of Eastern North America. Chapman.
2. Textbook of Zoology. Parker and Haswell.
3. Biology and Its Makers. Locy.
4. Manual for Study of Insects. Comstock.
5. Bird Life. Chapman.
6. Nature Study and Life. Hodge.
7. The Housefly. Howard.
8. The Butterfly Book. Holland.
9. Reports on Noxious and Beneficial Insects of Illinois. Forbes.
10. Animal Life. Jordan and Kellog.
11. Birds in Their Relation to Man. Weed and Dearborn.
12. Insect Pests of Farm, Garden, etc. Sanderson.
13. The Moth Book. Holland.
14. American Insects. Kellog.
15. The Cell. Wilson.
16. Manual of Vertebrates. Jordan.
17. The American Natural History. Hornaday.
18. Entomology. Folsom.
19. Applied Biology. Bigelow.
20. Domesticated Animals and Plants. Davenport.
21. Bird Homes. Dugmore.
22. Handbook of Nature Study. Comstock.
23. General Biology. Needham.
24. Introduction to Zoology. Hegner.
25. General Principles of Zoology. Hertwig.

AGRICULTURE.

The following references were reported to the 1913 Conference:

On Soil.

The Soil, F. H. King.
Soils, Brukett.
The Soil of the Farm, Scott & Morton.
Soils, Lyon & Fippinl.
First Principles of Soil Fertility, Vivian.
Soils and Fertilizers, Snyder.
Soils, Fletcher.
Fertilizers, Voorhees.
Soil Fertility and Permanent Agriculture, Hopkins.
Manual of Agriculture, Barto.
Soil Physics Laboratory Guide, Stevenson and Schwab.
Chemistry of the Farm, Warrington.
The Story of the Soil, Hopkins.
The Farm That Won't Wear Out, Hopkins.
Farmers' Bulletins 77, 266, 44, 192, 406, 144, 337, 245, 259, 315, 278, 187.
Illinois Bulletins, 115, 123, 125, 94.

Illinois Circulars 108, 109, 110, 116, 123, 124, 127, 129, 130, 149.
Valuable texts in general agricultural helpful in a course in soils:
A Laboratory Manual of Agriculture, Call and Schafer.
Practical Agriculture, Wilkinson.
Elements of Agriculture, Warren.
High School Agriculture, Mayne and Hatch.
Productive Farming, Davis.
One Hundred Lessons in Agriculture, Nolan.

On Stock.

1. General:
   Harper: Animal Husbandry for Schools; Macmillan.
   Plumb: Beginnings in Animal Husbandry; Webb Publishing Co.
   Plumb: Types and Breeds of Domestic Animals; Ginn and Co.
   Davenport: Twelve Studies of Farm Animals; Parker.
   Purdue Circular No. 29.
2. Horses:
   Roberts: The Horse; Macmillan.
   Johnstone: The Horse Book; Breeder's Gazette.
   Bulletins:
   Illinois Bulletin No. 122, Purdue 190.
   Illinois Bulletin No. 150. Farmer's 170.
3. Cattle:
   Mumford: Beef Production.
   Eckles: Dairy Cattle and Milk Production; Macmillan.
   Bulletins:
   Purdue 153; Missouri 112. Ill. 137, 139, 142, 143, 149. Farmer's Bulletin 143-241, 106. Ill. Circular 152, 115.
4. Sheep:
   Wing: Sheep Farming in America. Breeder's Gazette.
   Kleinheinz: Sheep Management.
   Doane: Sheep Feeding.
   Shepherd Boy: Sheep Breeds and Management; Gazette.
   Bulletins: Ill. Bulletin 129; Ill. Circular 125.
5. Swine:
   Dietrich: Swine; Breeder's Gazette.
   Coburn: Swine; Breeder's Gazette.
   Dawson: Hog Book; Breeder's Gazette.
   Bulletins: Ill. Circulars 123, 136. Farmer's Bulletin 379.
6. Poultry:
   Bulletins: Farmer's Bulletins 51, 64, 357, 200, 287.
   Watson: Farm Poultry; Breeder's Gazette.
   Bulletins: Farmer's Bulletins 51, 64, 357, 200, 287.
7. Feeds and Feeding:
   Henry: Feeds and Feeding; Gazette.
   Jordan: Feeding of Animals; Macmillan.
8. Periodical: The Breeder's Gazette, Chicago.

THE UNIVERSITY OF ILLINOIS

THE STATE UNIVERSITY

Urbana

EDMUND J. JAMES, Ph. D., LL. D., President

THE UNIVERSITY INCLUDES THE FOLLOWING DEPARTMENTS:

The Graduate School

The College of Liberal Arts and Sciences (Ancient and Modern Languages and Literatures; History, Economics and Accountancy, Political Science, Sociology; Philosophy, Psychology, Education; Mathematics; Astronomy; Geoglogy; Physics; Chemistry; Botany, Zoology, Entomology; Physiology; Art and Design; Ceramics)

The College of Engineering (Architecture; Architectural, Civil, Electrical, Mechanical, Mining, Municipal and Sanitary, and Railway Engineering)

The College of Agriculture (Agronomy; Animal Husbandry; Dairy Husbandry; Horticulture and Landscape Gardening; Veterinary Science; Agricultural Extension; Teachers' Course; Household Science)

The College of Law (Three years' course)

The School of Education

The Courses in Business (General Business; Banking; Accountancy; Railway Administration; Insurance; Courses for Commercial Teachers and for Commercial and Civic Secretaries)

The Course in Journalism

The Courses in Chemistry and Chemical Engineering

The Courses in Ceramics and Ceramic Engineering

The School of Railway Engineering and Administration

The School of Music (four years' course)

The School of Library Science (two years' course)

The College of Medicine (in Chicago)

The College of Dentistry (in Chicago)

The School of Pharmacy (in Chicago; Ph. G. and Ph. C. courses)

The Summer Session (eight weeks)

Experiment Stations: U. S. Agricultural Experiment Station; Engineering Experiment Station; State Laboratory of Natural History; State Entomologist's Office; Biological Experiment Station on Illinois River; State Water Survey; State Geological Survey; Mine Rescue Station

The *library collections* contain (March 1, 1915) 336,612 volumes, including the library of the State Laboratory of Natural History (8,100 volumes), the Quine Medical Library (14,000 volumes), and the library of the School of Pharmacy, (2,000 volumes).

For *catalogs and information* address

THE REGISTRAR
Urbana, Illinois